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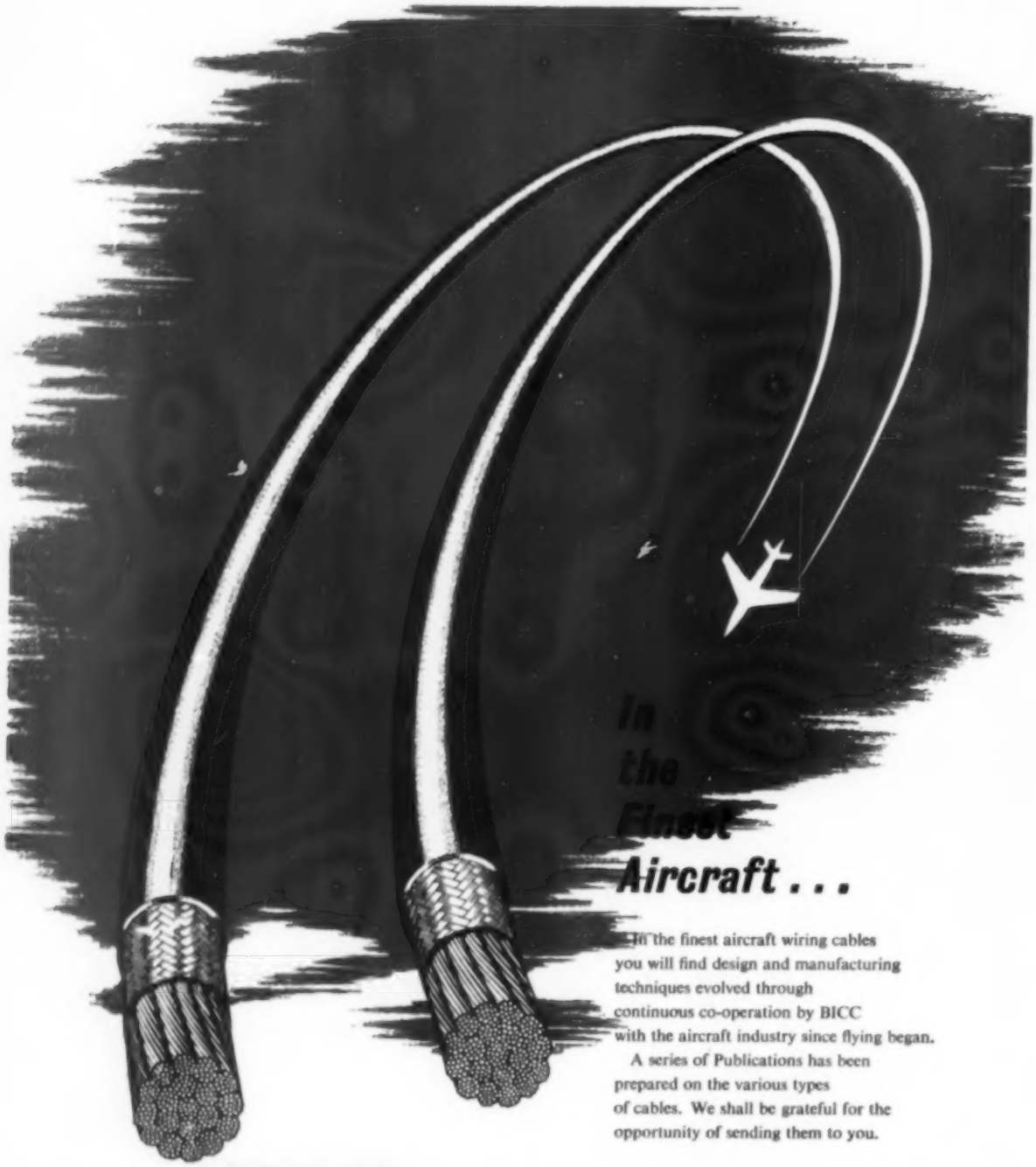

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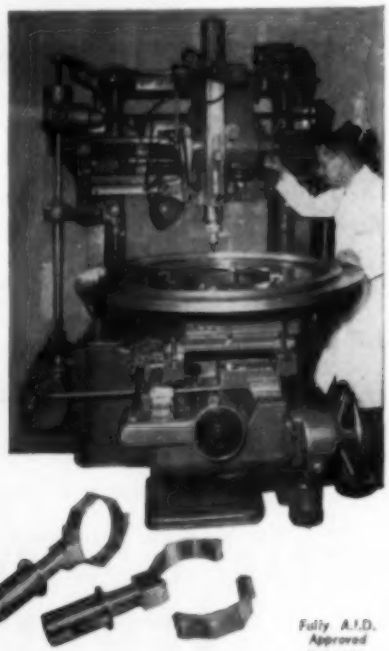

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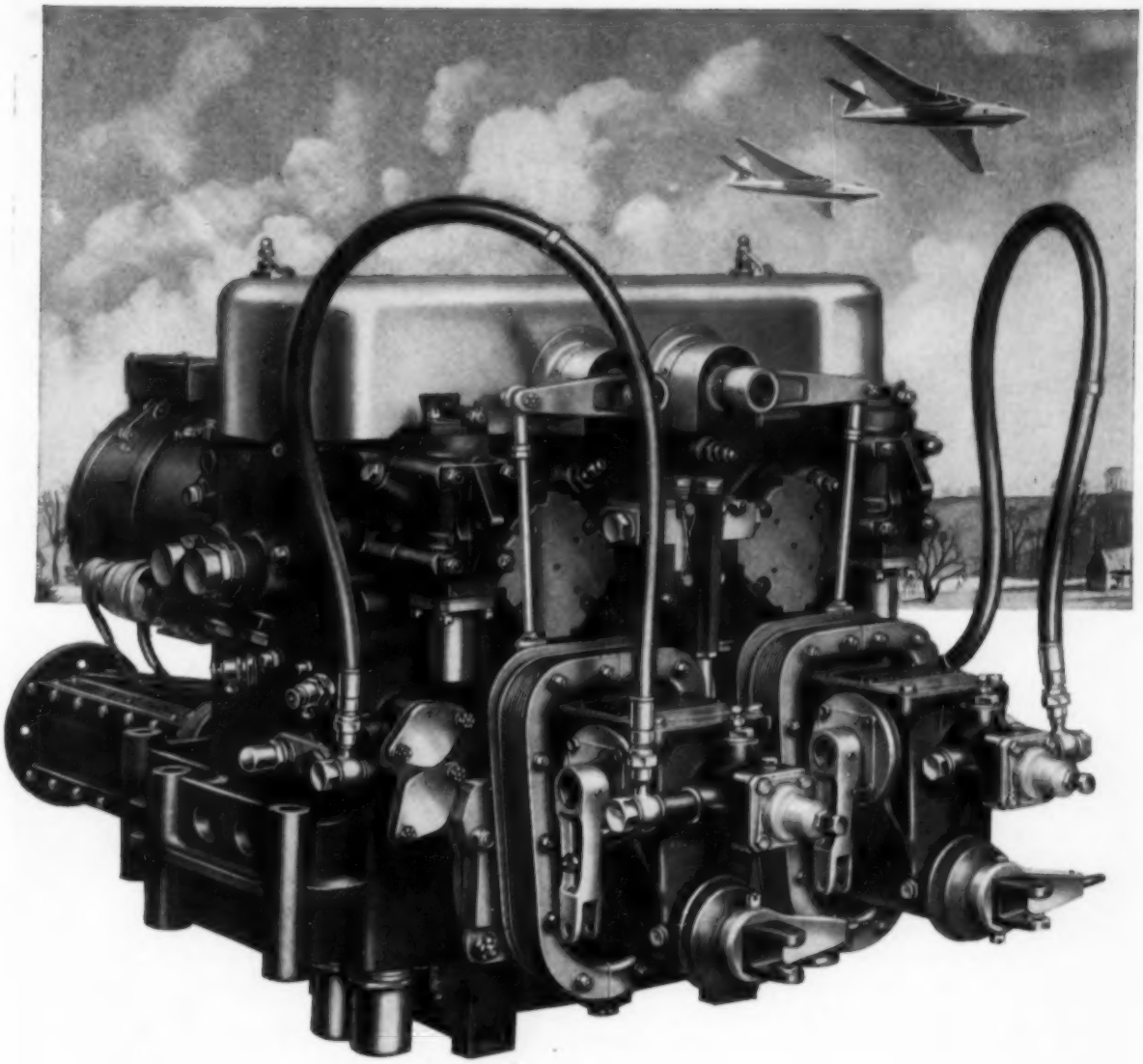

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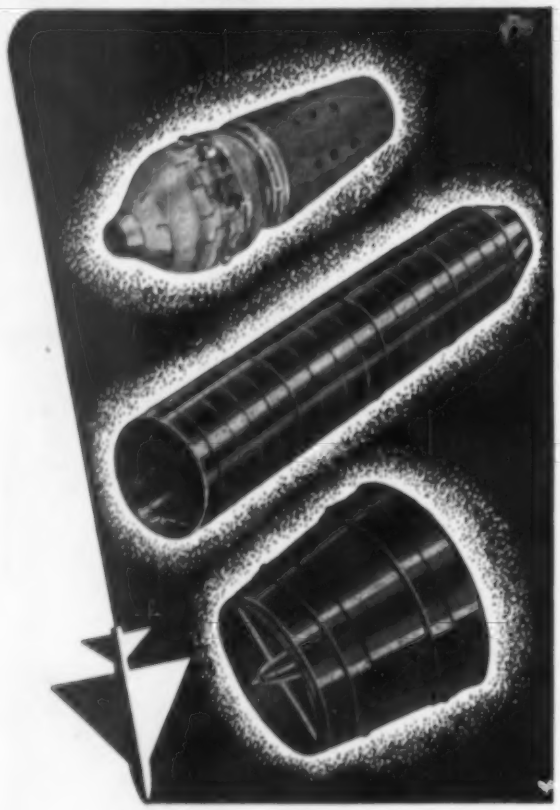

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Problems in Parallel

The considerations that have led to the adoption of Seamews for the Royal Air Force and the Royal Navy are of more than domestic significance. N.A.T.O. countries with long coastlines and islands to defend against submarines require large numbers of search-and-strike aircraft. They are needed to carry out *continuous* coastal patrols—probably from makeshift air strips—and to provide anti-submarine 'umbrellas' for convoys passing through coastal waters.

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Surveillance for Peace

PRESIDENT EISENHOWER's Geneva proposal that America and Russia should accord each other freedom of air reconnaissance to provide against the possibility of a surprise attack has left the world breathless by the sheer grandeur of its concept. Yet the essence of the idea is simplicity and directness . . . "we to provide you with ample facilities for aerial reconnaissance, where you can make all the pictures you choose and take them to your own country to study; you to provide exactly the same facilities for us."

It is not to be supposed that the President is unaware that such inspection could be no certain index to a country's preparedness for war, for that is increasingly an affair of hidden labour on small devices, no longer proclaimed by the massing of men and machines. True, air reconnaissance, as in the late war, is a rewarding medium of military, technical and industrial intelligence. But there can be precious little which is not already known to the Russians concerning America's military dispositions, the essential characteristics of all her aircraft and of other standard weapons, and the extent and deployment of her strategic industries. Thus, the cynic might argue that in a merely military sense America would stand to gain from such an arrangement infinitely more than Russia, not only from her own observations but because flights over her national territory by Soviet aircraft might afford a closer acquaintanceship with very advanced types of machines which have hitherto been only fleetingly glimpsed in the Tushino fly-pasts.

Yet in face of the President's profound sincerity (which is acknowledged by the Russians themselves) such argument becomes sterile. This remains: that air reconnaissance, now the very spearhead of offence, may yet become the instrument to prise apart the barriers of fear.

Independent but Inter-dependent

AFTER a General Election as quiet as that completed earlier in the year, one is apt to overlook the fact that we have a new Government with a good-sized majority and a mandate to go ahead with the programme which was started in the previous Parliament.

Naturally enough, air transport and the Civil Aviation Act will be examined in due course—perhaps very shortly after the Summer Recess. The national Corporations are unlikely to be subjected to any changes; they are doing a good job, and while they may not always have been as efficient as might have been wished, we would not care, even in retrospect, to suggest any better way of achieving a B.O.A.C. and B.E.A. in the time and circumstances since the war.

There are several commercial aviation matters which should, and will be, reviewed; they may be grouped under the heading of restrictive practices. Though we have in mind purely national interests, the remark would apply aptly to certain international ones. Any agreement which has the effect, directly or indirectly, of reducing the standard of service to the passenger or of holding the fare higher than it need be will, in the long run, be to the disadvantage of the air transport companies.

The operators most concerned in any changes which may be made are the so-called independents, but in the past opportunities have been lost because these companies have, in the main, been singularly difficult to deal with—if we are to accept the opinions of interested M.P.s on both sides of the House. We believe that the Government would now welcome from the independents constructive criticism rather than mere complaints or, where there are genuine grievances, facts to substantiate them. Above all, they would like to hear the independent operators speaking with one voice over major issues that are of mutual interest to them and which may be expected to come under discussion when Parliament reassembles.

FROM ALL QUARTERS

SOUTH BANK SMILES on the occasion of the inauguration of B.E.A.'s scheduled helicopter service to and from London Airport registered by, l. to r., Mr. John Profumo, Joint Parliamentary Secretary to the M.T.C.A., Mr. Peter Masefield, chief executive of B.E.A., Mr. Norman G. M. Pritchard, Chairman of the L.C.C., Mr. J. A. Boyd-Carpenter, the Minister of Transport and Civil Aviation, Lord Douglas of Kirtleside, chairman of B.E.A., and Capt. "Jock" Cameron. (News story, page 173.)

Coach/air Integrated Services

AN important step in making the advantages of air travel available to many more people in this country has been taken by Skyways, Ltd., of 7 Berkeley Street, London, W.1. Last Tuesday they announced their intention of inaugurating a Continental coach/air service—not to be confused with what are commonly known as "air coach" services—between England and France. The plans are well advanced, and it is hoped that the first of these integrated services will begin towards the end of September.

Two reasons why air travel is being adopted rather more slowly in Britain than in, say, America, are the cost of fares in relation to salaries, and the availability of acceptable alternative means of travel, involving little extra time, over the shorter distances to be covered. Skyways appreciate that a large section of the British public awaits introduction to air travel and, in fact, to Continental holidays. Coach/air, they feel, will provide an answer.

By arrangement with motor-coach operators, passengers will be picked up at many (and eventually almost any) points in England, Scotland and Wales, driven to Lympne airfield, flown to Beauvais and then driven on to Paris (Place de la Republique) or, later, other destinations in France.

Prolonged negotiations have led to the taking over of Lympne airport by Skyways. It will be re-opened and operated by them with a common-user licence. The French are busily building, and otherwise improving, at Beauvais airport.

The aircraft to be used are DC-3s fitted to carry the same number of seats as the coaches, namely, 32. Normal baggage allowances will be made, and the flying section will be treated as a scheduled, tourist-class service. Flight time will be approximately 35 minutes.

It is planned to operate 21 return services daily all the year round. For a start, one or two daily services will run from Victoria coach station, London, to Paris *via* Lympne and Beauvais. Skyway's assessments of time-and-money savings, city centre to city centre, and including incidental charges, include these London-Paris return-fare examples: coach/air, £8 15s, time 6 hr 50 min; rail and boat (second class), £12, time 7 hr 10 min; ordinary air fare (tourist), £15 9s 3d, time 3 hr 10 min; typical saving, £3 5s; or £4 on Birmingham-Paris route or £4 8s Manchester-Paris.

It is reported that Lympne has been leased to Skyways by Mr. J. M. Beecham, director of a London shipbroking firm. Having failed to sell the airfield by auction after it was closed last year, the M.T.C.A. recently sold it as agricultural land, the buyers being some of the successors in title to the former owners. Mr. Beecham, successor in title to the largest portion—86 of the 229 acres—is understood to have purchased the whole area.

Marine Turbojet Record

MUCH well-merited acclamation followed Donald Campbell's raising of the water-speed record from 178.49 m.p.h. (held in America) to 202.32 m.p.h. on Ullswater last Saturday. The jet engine which powered the 24ft hull, however, received little publicity. Aeronautically, it was an obsolete type—a Metropolitan-Vickers Beryl of 4,000 lb thrust—but, once the difficulties of keeping water out of the intake had been overcome, it provided all the power and reliability required. A. Cdre. F. R. Banks, when Principal Director of Engine Research and Development, M.o.S., originally made two Beryls available, and the third—the one used for the record—was loaned by the College of Aeronautics. Metropolitan-Vickers rebuilt all three engines without charge.

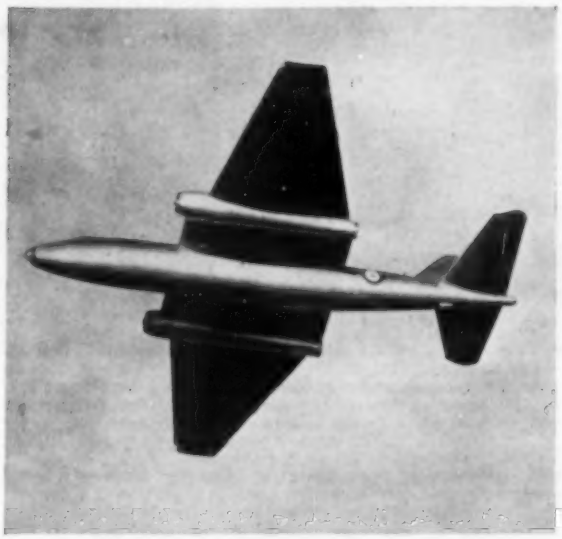
The hull had to be of extremely strong construction to withstand the severe hammering engendered by travelling over even only slightly broken water at 200 m.p.h. Built by the Salmesbury Engineering Co., it weighs less than 600 lb and is welded from some 275ft of Accles and Pollock steel tubing.

As we go to press there are rumours that Campbell may try this week to push the speed still higher; and that Ray Crawford, on a lake near Las Vegas, is preparing for an attempt to regain the record for America. Campbell has been invited to take *Bluebird* to Las Vegas.

The High and the Lucky

TO some extent paralleling the story of the best-seller and film, *The High and the Mighty*, two U.S.A.F. aircraft have landed safely after similarly unpleasant and protracted misadventures. One, a B-29 weather aircraft from Burtonwood, Lancs., succeeded in flying 500 miles to Prestwick after feathering two engines

PANOPLY: Bedecked with weapon rails beneath the wings, with a new, temporary, under-fuselage air brake, and—most remarkable of all—with a test-probe which would have been the envy of Sir Galahad himself, is this Naval D.H.110, photographed at Ford last weekend. (Display report, p. 149.)
"Flight" photograph



VARIANT 9 of the English Electric Canberra is this new long-span photographic-reconnaissance version, designated P.R.9. Span is 68ft, and, as seen here, the chord of the inboard portions of the wing has been deepened. Tank attachments are now slightly inboard.

VARIANT C of the North American F-100 Super Sabre is a fighter/bomber, reported to be able to carry an atomic bomb at speeds in excess of Mach 1. Here its load is four conventional bombs and two auxiliary tanks. Provision is made for flight refuelling.

because of fuel leakage and fire. One of the engines was restarted and kept running for 90 min during the final effort to reach land. A rescue aircraft escorted the B-29, ready to drop a lifeboat.

The second incident involved a C-124 Globemaster carrying 79 troops from Hickam Field, Honolulu, to Hamilton A.F.B., California, in connection with the relief of a garrison unit in the Far East. Two engines failed far out to sea and rescue aircraft and ships were dispatched to escort and wait for the aircraft, but the pilot managed to reach his destination and make a landing. The two tyres on the starboard main undercarriage leg burst on touch-down, but the Globemaster came to rest otherwise undamaged.

A different but equally unpleasant sort of incident occurred when the whole 32ft-high rudder of a B-36 fell off in flight over Colorado, leaving only the fin. With a crew of 29 on board, the pilot made a successful emergency landing at a U.S.A.F. base in South Dakota, using aileron for directional control.

Sir James Barnes Joins Short Bros.

Sir James Barnes

THE Board of Short Brothers and Harland, Ltd., have appointed as a director Sir James H. Barnes, K.C.B., K.B.E., who was until recently Permanent Under-Secretary of State for Air. The announcement was made last week by Rear Admiral Sir Matthew Slattery, the chairman and managing director. Sir James, who is 64, was educated at Manchester Grammar School and Merton College, Oxford. He had been Permanent Under-Secretary of State at the Air Ministry since 1947.

Airport Improvements in America—

THE U.S. House of Representatives has passed a bill authorizing a federal expenditure of $232 million (£82,857,000) over the next four years for the improvement of airports and the construction of new ones. The vote was 145 against 52. The bill now goes back to the Senate, which has already approved a $252 million (£89 million) four-year airport programme.

— and Canada

THE construction of new airports and the enlargement and improvement of others is planned for this year by the Canadian Department of Transport. Two projects concern Malton (Toronto) Airport. Work will be put in hand on runways, taxiways and parking aprons at Charlottetown, Prince Edward Island; Fredericton, N.B.; Timmins and London, Ont.; Winnipeg; Yorkton, Sask.; Calgary, Alta.; Vancouver, B.C.; and Yellowknife, Northwest Territories. It is hoped that land clearance will be started for new airports at Halifax, Nova Scotia, and Alkavik, Yukon, and the Transport Department is examining various sites for another at Edmonton. Also in prospect is the expenditure of $3½ million on radio aids, and there are projects for the completion of visual omni-ranges between Montreal and Windsor, Ohio, and for the start of a similar installation on the Toronto-Winnipeg route. At Gander a new transmitting station is to be built at a cost of $300,000. In conjunction with the R.C.A.F. work will start at Churchill, Manitoba, on new radio facilities to extend communications in the north. Substantial orders will be placed (for delivery in 1956, '57 and '58) for V.O.R. installations to complete equipment of the whole trans-continental airway, and provision is being made for special surveillance radar for improved traffic control around the large airports. This will have a range of 90 miles and an effective height of 50,000ft.

Australia's Edinburgh

THE increasing tempo of Australia's weapons-research programme is reflected in an announcement that Edinburgh Airfield, Salisbury, South Australia, is to be enlarged at a cost of £A1,500,000, the cost to be shared with Great Britain. The airfield, which is the centre of the flying activities of the Australian Weapons Research Establishment, was opened and named last year by the Duke of Edinburgh.

It is further reported that a "Valiant 4" bomber will soon arrive in Australia for trials at Woomera, and that a special hangar will be required to house it.

British Engineer's Senior U.S. Appointment

IT is announced that Mr. Jeffrey Watkins, A.F.R.Ae.S., A.S.M.E., formerly with the performance department of D. Napier and Son, Ltd., has been appointed senior aerodynamicist of the Solar Aircraft Co. of San Diego, California.

After service as a pilot in the R.A.F., Mr. Watkins was with Napiers for six years before going to Canada to join A. V. Roe (Canada), Ltd. Later he took up a post with the Westinghouse Electric Corporation of South Philadelphia.

Tennant Saves the Gnat

CHIEF test pilot to Folland Aircraft, Ltd., S/L. E. A. Tennant —whose portrait appears overleaf—must be heartily congratulated on saving the Gnat prototype when, on Friday morning last, its cockpit canopy blew off at 20,000ft.

Dazed and cut about the head. and with his helmet, oxygen mask and microphone torn away, Tennant kept control. Without his microphone he could give no warning of his predicament, with the result that, when he managed to get the light fighter

COMPARISON between the Folland Gnat (left) and Midge is facilitated by this photograph, taken at Chilbolton, where—as we reported last week—the Gnat landed after its maiden flight on July 18th. Test-pilot Tennant expressed himself "highly delighted," as the inset picture, taken two minutes after touch-down, confirms. Four days afterwards, as related here, he was to have a less happy experience.

FROM ALL QUARTERS . . .

down to Chilbolton, he found the runway obstructed. He immediately decided on a wheels-up landing on the grass and brought it off successfully. Then he was taken to hospital, but not detained.

The Gnat suffered damage to the underside of its fuselage, but it was back at the Folland works at Hamble within a matter of hours. The makers are confident that it will be flying again within a few weeks, and will certainly be ready for the Farnborough Show.

" . . . on the Air Ministry Roof"

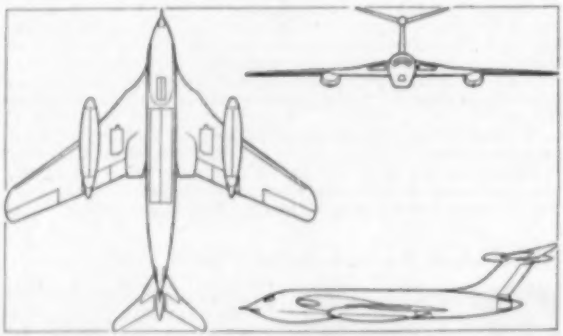
A DECCA Type 41 radar has been installed experimentally on the roof of Victory House, London, the Air Ministry building occupied by the Meteorological Office. Although by no means the first of these sets to be put into service—several are located in Africa and India—its use in London marks a further step towards the development of weather-watching, as opposed to recording and forecasting. Information thus obtained will be supplied through the normal channels to such agencies as the B.B.C., and also to private enquirers. The use of the Type 41 is still, however, purely experimental, and the efficacy of both the equipment and the technique remains to be proved in this particular application. Those sets which, in conjunction with the earlier Type 40, first installed some years ago at Entebbe, Uganda, are already in use have given excellent results.

Heavy precipitation and thunderstorms can be located up to about 100 miles (depending on their height) from the scanner and their progress watched, enabling the users to forecast local conditions some three to four hours ahead. The exact extent of a storm could be located and an opinion given as to whether it would be likely to move across, say, cricket grounds. In the light of experience during the next twelve months the usefulness of the set will be established.

The Decca Type 41 has the same 14ft parabolic aerial as the Type 424 airfield radar, with a horizontal beam of 0.75 deg and 4 deg. It rotates continuously at five to six r.p.m. and can be tilted between minus 2 deg and plus 12 deg. Peak power is 25-30 kW. Extreme range is 250 nautical miles, but in practice the earth's curvature limits the use of this range to some 150 miles.

The display is on a 12-in long-afterglow screen with controls for varying ranges, range-ring setting, Deccaplot plotter and differentiation against clutter. Frequency is in the X-band, between 9,320 and 9,500 Mc/s.

SCANNER of the Decca Type 41 weather radar mounted on the roof of Victory House, Kingsway (see accompanying news item).



APPENDAGES under the wings—bomb containers?—were apparent in H.P. Victor silhouettes (from which these G.A. drawings have been made) published in the July issue of the official publication of the U.S. Navy, "Naval Aviation News."

Avon-Sabre Simulators

THE Royal Australian Air Force has placed an order with Redifon, Ltd., for a number of simulators for the Commonwealth Avon-powered Sabre Mk 30. Two types are involved, one for installation in a special permanent building and the other mounted in an air-conditioned trailer. Redifon simulators for several marks of Sabre have already been delivered to the R.C.A.F., most of them in mobile form.

Australian pilots now preparing to take over Sabres in squadron service will complete some 20 hours of simulator flying, including complete emergency procedures, before they make their first flight in the actual aircraft. In the mobile trainer full air-conditioning ensures proper operating temperatures regardless of climate and temperatures actually experienced in flight are produced. Lighting is also adjusted to give the effect of night, day or twilight and the sounds of tyre-squeal and gun-firing are heard in the cockpit. The computing section of Redifon simulators is electronic.

The Ministry of Transport and Civil Aviation recently approved the use of another type of Redifon simulator for air-line-crew training as a valid subsitute for actual flying time. It allows the simulation of emergencies which would not be feasible in an actual flight, offers more concentrated training per "flight" hour and saves considerable aircraft operating costs.

From PUP to D.H.110

ALMOST rained-out last year, H.M.S. *Peregrine's* annual air day was favoured last Saturday with all that could be wished for in the way of sunshine; from the adjacent Sussex seaside resorts holidaymakers converged on Ford Airfield in their thousands. From the pilots' point of view, perhaps, the conditions were less perfect, for there was a concomitant heat-mist that must on occasions have made positioning difficult.

The visitors certainly had their moneysworth, for in addition to a static show that included such modern equipment as the deck-landing mirror (the Service Trials Unit is at Ford) they were able to see some three hours of flying which, if at times a little repetitious, gave a remarkably complete picture of modern Fleet Air Arm activities.

H.M.S. *Peregrine*, which is commanded by Capt. L. E. D. Walthall, has as its Commander (Air) Cdr. G. C. Baldwin, who, with Cdr. D. A. Shaw as Executive Officer, was responsible for the day's organization. The display had been given the S.B.A.C.'s blessing, which meant that several new aircraft could be demonstrated by their makers' test pilots.

There was a spectacular send-off to the display when, simultaneously with the launching of 50 coloured rockets, the starter-cartridges were fired in 24 Sea Hawks of Nos. 803, 806 and 764 Squadrons, the aircraft—led by Lt-Cdr. T. Innes, C.O. of 803—then proceeding to a stream take-off from the main E-W. runway fronting the long public enclosure.

Now followed brief demonstrations by a Wyvern (Lt-Cdr. S. C. Farquhar) and a Gannet (Lt-Cdr. F. E. Cowtan), showing their capabilities both fast and slow, and the Gannet opening its bomb-doors and extending its radar bin. Then two Dragonflies (located near opposite ends of the enclosure, so that everybody had a fair view) demonstrated rescue techniques, first by strop and then by Sproule scoop; Lt-Cdr. J. S. Sproule, inventor of the latter valuable device, flew one of the two.

The Sea Hawks came back in two formations, four from No. 803 breaking away to give one of their now familiar but always stimulating formation aerobatic shows. We understand, incidentally, that the team does not always consist of the same four pilots; any of 803's or 806's pilots may be selected for a quartet, and any one of them can act as formation leader.

As the first of four light-hearted interludes, an improbable-looking "aerial cyclist" passed at speed along the enclosure, suspended within 10ft or so of the ground on a long winch-cable from a Dragonfly. The other three turns, seen at intervals later, were Eros (no bicycle, but a small drogue for stability in yaw), a most convincing broomstick witch, and a gentleman in a bed, the drogue in this case being of a familiar domestic shape.

Next, Lt-Cdr. D. F. W. Kelly, 806's C.O., went through his amazing solo aerobatic *repertoire*, complete with low inverted pass the length of the runway, a slow loop with the Sea Hawk "standing on its jet," and a superb eight-point roll. If we were not the victims of an optical illusion, his recovery from his final loop took him between two trees.

Aerobatics without benefit of engine were next contributed by Sub-Lt. C. Hughes in an Olympia borrowed from Southdown Gliding Club and released from a Tiger Moth, which presently bore the sailplane off post-haste for Lasham; and then it was time for brief but nostalgia-generating displays by four historic aircraft, three of them handled by test pilots—the Swordfish (Lt-Cdr. M. W. Rudorf); Fulmar (civil-registered G-AIBE, and actually the original prototype, flown by Peter Twiss); Spitfire (the well-known "Battle of Britain" replica, flown by "Chunky" Horne; and the Shuttleworth Collection's Sopwith Pup. This last veteran was most nimbly handled by Vickers-Supermarine sales manager Jeffrey Quill, flying it for only the second time.

The Martin-Baker company's "Meteor 7½," flown by Capt. J. E. G. Scott at under 200ft, gave a dummy ejection-seat demonstration, the vital sequence happening with bewildering speed but the main canopy fully developing.

After an efficient ambulance display by a Bristol Sycamore flown by "Sox" Hosegood it was the turn of the new types. First was the Seamew, showing pronounced aerobatic proclivities in the hands of Wally Runciman; then came the Midge, flown fast, slow and fast by Dick Whittington and looking as pretty as ever; and finally the D.H.110 (Jock Elliott), giving a much less inhibited display than it had at Lee-on-Solent a fortnight earlier, for the experimental "barn door" air brake under the nose was now fully retractable. "And could those be weapon rails under the wings?" observed Cdr. G. Baldwin, who was providing the admirably informative loudspeaker commentary.

Eight Firefly 6s of the Channel Air Division, R.N.V.R., led by Cdr. N. A. Bovey, now took the air in succession, the last four using take-off rockets that seemed less noisy, less smoky, shorter-burning and less spectacular than usual. These were followed by stream take-offs of Sea Vampires and Sea Hawks of 764 Sqn. (Lt-Cdr. D. Battison) and Sea Venoms of No. 891 (Lt-Cdr. M. A. Birrell), the last-named four aircraft then contributing a brief aerobatic demonstration in opposed pairs from opposite directions; the four concluded with a "bomb-burst" breakaway, during which one of them demonstrated fuel-jettisoning from its tip tanks.

The Fireflies and Sea Vampires returned to make a low-level attack on a "terrorist stronghold"—a small oasis of brushwood which erupted, somewhat unconvincingly, a succession of pops, bangs and coloured smoke puffs, to be finally subdued by troops deposited by S-55s (which arrived and departed in spectacular style, making steep turns at zero feet) and reinforcements parachuted down from a balloon "simulating aircraft of R.A.F. Transport Command."

Eight Sea Hawks of No. 806, flying four in a box and two in pairs, provided an excellent aerobatic *grand finale*. The foursome concluded with a spectacular "bomb burst" in which each aircraft broke away in an upward roll.

"Flight" photograph

Lt-Cdr. Kelly performs one of his inverted passes in the Sea Hawk, with the Sopwith Pup providing chronological contrast.

"Flight" photograph

Saved from a grassy grave by a Dragonfly equipped with scoop net.

(Below) Three squadron C.O.s: Lt-Cdr. D. F. W. Kelly, No. 806; Lt-Cdr. D. F. Battison, No. 764; and Lt-Cdr. T. C. Innes, No. 803.

HERE AND THERE

The SeaMaster Flies

THE first flight of the Martin SeaMaster four-jet flying-boat was made at Baltimore last week. The great boat, which is powered with four Allison J71 turbojets, was airborne for two hours. Designed primarily for mine-laying, it is also suitable for photographic reconnaissance, having a top speed of over 600 m.p.h. and the ability to cruise at 40,000ft.

U.S. Airfield Construction Funds

THE American House of Representatives has approved a sum of $2,360,530,000 (about £845 million) for airfield construction, half of which will be used for new bases outside the U.S.A. The measure has still to be approved by the Senate.

Poland's Jets

THE 10th anniversary of Poland's "liberation by the Red Army" was marked on July 22nd by military parades and by a fly-past over Warsaw. A commentator repeatedly stated that the "flights of twin-jet bombers escorted by jet fighters" were of Polish construction, as were jet fighters which, at the end of the fly-past, "flew over Warsaw at the speed of sound."

India and the Vautour

A FLIGHT was recently made by W/C. Akut, air attaché at the Indian Embassy in Paris, in the bomber version of the S.O.4050 Vautour. Supersonic speed was achieved in a dive. India is known to be in the market for twin-jet bombers, and has displayed very close interest in the English Electric Canberra.

Gesture

IN recognition of his invention of the scoop net—which, used by Naval helicopters, has already saved at least four lives at sea within a few months—Lt-Cdr. John Sproule has been awarded £30 from the Herbert Lott Naval Trust Fund (Mr. Lott died in 1947 and bequeathed his fortune to the Admiralty, to establish a fund to reward personnel "who devise or improve Naval equipment which would encourage battle efficiency"). Co-inventor of the net with Lt-Cdr. Sproule was C.P.O. Stewart Lock; he receives £20 from the fund.

MAGYA POSTA reveals these stamps as a new Hungarian issue. Aircraft types include standard trainers (basic design being that of the Bücker Jungmeister and Bestmann), an undistinguished-looking transport (Yak-16?), sailplanes and twin-canopy parachuting. The highest denomination illustrates the ubiquitous Mig-15.

Models and Inventions

THIS year the Model Engineer Exhibition is being held jointly with the Exhibition of Inventions. Both are at the New Horticultural Hall, Westminster, from August 17th to 27th.

In Short

REJOICING in the handy name of Vliegtuigmotorenoliekoelergeluidsgolvenwasmachine, equipment for cleaning engine oil-coolers and other components by ultrasonic waves has been developed by the K.L.M. maintenance base at Schiphol.

Persian Airfield Contracts

TEHERAN RADIO reports that an agreement has been signed with a British firm of consulting engineers (not named) for the expansion and development of Mehrabad Airport in Teheran and five other Persian civil airfields.

Power for Weight

A NEW American light aircraft engine, the Nelson H-59, is stated to give 40 h.p. at 4,000 r.p.m. for a weight of 39.6 lb and fuel consumption of 3.6 gal/hr at full power and 2 gal/hr at cruising power. The H-5 is a flat four with a capacity of 993 c.c.

The Rapier or the Bludgeon?

A REPORT of the International Council of Military Sports states that the best sport for pilots is fencing. Experts of the Italian Aeronautical Medical Research Centre, who contributed, said that "there is a profound analogy between aviation and fencing." The fencer combats . . . a thinking person and the struggle is fought at terribly close quarters and with movements of lightning rapidity." The Air Ministry stated that fencing "seems to go down better among hot-blooded nations. . . Nearly everybody in the R.A.F. would put Association football first, with a good deal of emphasis on other team games like Rugby football."

Fiat Turbojets

IT is reported that the Italian Fiat company is designing three new turbojets, ranging in thrust from 1,100 lb to 6,600 lb.

Heavy Work

ACCORDING to reports from New Zealand, 50 Cessna aircraft used for aerial top-dressing have been grounded for undercarriage inspection by order of the D.C.A., Mr. E. A. Gibson. This step follows four undercarriage failures, and it seems possible that in future the all-up weight may be restricted to that for normal passenger load instead of the agricultural load.

Olympic Airlift

AUSTRALIAN and overseas airline companies are combining to arrange for the transport of great numbers of visitors to Australia for the Olympic Games in Melbourne next year. Representatives of thirteen airlines and the Department of Civil Aviation have formed a committee known as the Olympic Games Air Transport Co-ordination Committee, which will meet regularly to decide the best measures to bring in the greatest number of visitors. Schedules will be planned to prevent congestion. There will be no reduction of fares between Australia and Europe or North America during the Olympic period.

LT-CDR. J. S. SPROULE, whose invention of the helicopter scoop net (see above) has been recognized by an award from the Lott Trust Fund.

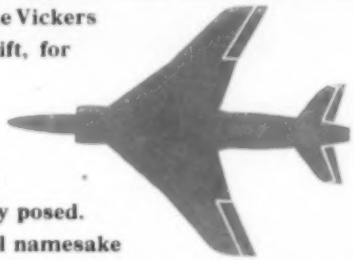
AUSTER FOR AUSTRIA: Seen on the right are Robert Elias (left), C.F.I. of the Austrian Rescue Squad and the Graz Flying School, with Friedrich Truley, chief parachute instructor of the Rescue Squad. They were recently at Rearsby to collect a specially equipped Auster Autocar for the Austrian Red Cross authorities.

Problems of flight

WING SHAPES

Nature is a master of aerodynamics. She has devised, for the infinitely varied needs of her flying creatures, every wing that man could ever need.

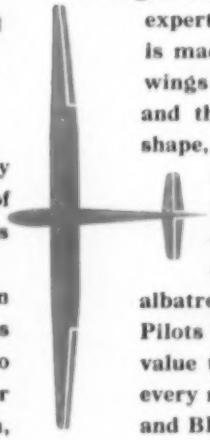
The wing of the Vickers Supermarine Swift, for example, solves problems that new engines and new enemies have only recently posed.



The Swift's small namesake needs speed as pre-eminently, for it lives largely on the tiny, almost invisibly fast-flying gnats of river-side and meadow. For this bird as for this aircraft swept-back wings are the answer.

The pheasant has very different needs. It lives in woodland, feeding and breeding on the ground. Its safety depends on its steep " rocketing " climb. So its wings are short for speed, broad and arched for maximum lift. Man's solution of the same problem, in carrier-based aircraft, is the same: the Hawker Sea Hawk needs the pheasant's short take-off and steep climb; so it has the pheasant's short broad wing shape. One other striking example among thousands is the albatross.

Among all birds the most expert glider, it is made so by its wings — narrow, and the longest of any bird. This wing shape, too, has been taken over by man to answer the special problems 'of soaring flight'. The wings of the sail plane exemplify exactly the same aerodynamic principles as those of the albatross, and to the same end.



Pilots whose planes have wings of any shape value the excellent and helpful service, at every major airfield in Britain, of the Shell and BP Aviation Service.

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Copies of this advertisement can be obtained from Shell-Mex House.

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on the Sycamore . . .

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CITY HELICOPTER TRAFFIC

Some Thoughts on Airstops and Traffic Control

By J. MacDONALD

IN November last year the foundation stone of the future Paris airstop was laid. Construction is to cost 1½ million pounds, and it is estimated that when it is ready there will be a helicopter service between London and Paris every 20 minutes. This year Belgian Airlines plan to extend existing Continental schedules to include regular flights between Brussels and London.

Let us look at London and see where, should it arise, all this traffic is likely to terminate, and examine possible arrangements which might be made in preparation.

The South Bank airstop (Fig. 1) introduced a little over a year ago, is essentially an interim arrangement. This site, the life of which is limited by building-development plans, offers at the moment a patch of concrete measuring some 300ft × 100ft. Any facilities which are provided have to be brought in when required, and withdrawn in entirety when flying has ceased, since the alighting area then reverts to the category of public gardens. A maximum of three aircraft of size equivalent to the S-55 can be accommodated in the space available.

The dimensions of the Piasecki helicopter, 134ft overall and standing 25ft high, gives us some idea of the size of alighting areas which must be considered in the future. Allowing for terminating and international services, a total area of something like 500ft × 700ft is likely to be required (shown by the dotted area in Fig. 1).

There are four attractions in the roof-top site: (1) Since the building which supports it may be used for other purposes, it puts highly valuable land to more economic use. (2) Accommodation in the building may be let and thus help to defray a substantial part of the total cost. (3) Operationally it will be more satisfactory, since there will be few obstacles in the approach path. (4) Alighting on ground sites between large buildings will undoubtedly be difficult, and ground sites in large cities may for this reason have to be larger in area than roof-top sites.

In most cases it would be impracticable to adapt or strengthen existing roofs and it is therefore inevitable that heavy capital expenditure will be required, and there will be town-planning problems. An official survey some four years ago estimated that a five-storey building giving a roof area of 300ft × 150ft in each of two directions would cost around £1,200,000.

The building or buildings which form the base should, generally speaking, be as tall as possible so that the expense of roof strengthening would be but a small proportion of the cost of the main structure. It should not be necessary to think of anything higher than the proposed Paris airstop, which will reach to approximately ten storeys (Fig. 2).

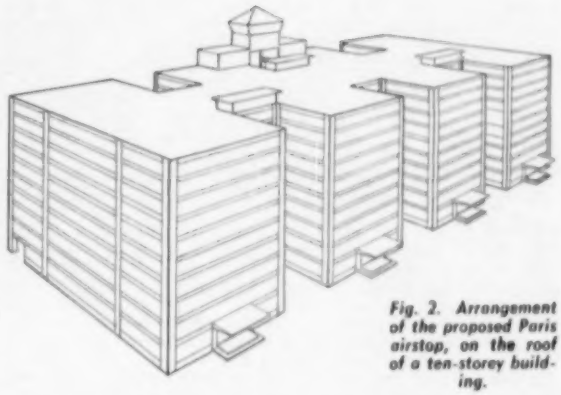


Fig. 2. Arrangement of the proposed Paris airstop, on the roof of a ten-storey building.

It is likely that helicopter traffic will make use of a system on the lines of the Decca Navigator. One authority has specified a course indication sufficient to enable the pilot to remain ± 300ft horizontally and ± 150ft vertically from the centre of his prescribed track up to a distance of 75 miles. Since helicopters will be largely confined to the airspace between 500ft and 1,500ft any navigational system must be capable of providing satisfactory information from ground level upwards and must be free of atmospheric effects, fading and line-of-sight limitations.

A recent forecast indicates that the ultimate navigational system will be by means of airborne radar, with ground reflectors provided where required.

The helicopter must offer at least the same schedule reliability as surface transport, and therefore a let-down aid must ultimately be available to provide a means of alighting at the landing area in zero conditions, from any direction, and at relatively steep approach angles, depending on terrain, winds and obstructions if any. There is a future here for G.C.A. controllers—given the right equipment.

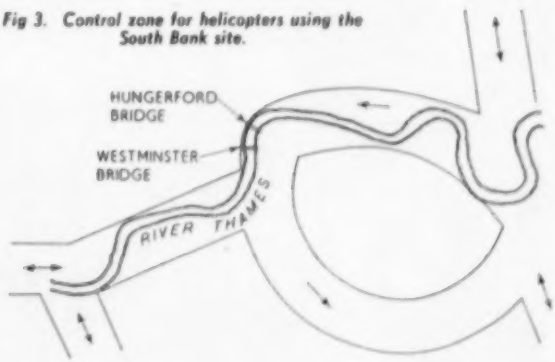
In ten years' time, it has been calculated, New York City will have 300 helicopter movements per day. In the U.K. we can expect a somewhat lower frequency, but we can depend on more inclement weather conditions. We must therefore be ready with a collision-avoidance system which will allow for considerable traffic expansion later.

Airways specifically for rotating-wing aircraft must be established on the same principle as those provided under the National Airways scheme. Their dimensions will be, perhaps, half-a-mile either side of the prescribed track and vertically between 500ft and 2,000ft above terrain. Control zones of three miles' radius and 2,000ft high may be necessary at certain junctions and terminals (Fig. 3).

Contd. overleaf

Fig. 1. The South Bank site and its surroundings. Latterly the grass area has been used as well as the concrete (shown in black). Dotted lines mark the 500ft × 700ft "ideal" area.

Fig 3. Control zone for helicopters using the South Bank site.



CITY HELICOPTER TRAFFIC . . .

In high-density areas such as London, radar monitoring will undoubtedly be required. Specification for coverage has been stated as 500ft above ground level to a distance of beyond 30 miles. M.T.I. will be of advantage since, even when hovering, the helicopter produces a good echo from the rotating rotors.

One of the problems will be radio communication. The fact that the traffic will be confined to the lower flight levels and may be screened by buildings or other obstructions naturally hinders the use of V.H.F. or U.H.F. At the South Bank site, for example, County Hall effectively cuts down the efficiency of communications between A.T.C. and aircraft approaching from up river at 500ft until the aircraft reaches (approximately) Lambeth Bridge.

An arrangement on the lines of the existing multi-carrier system is likely to be required, not so much for extending the range as for filling in awkward gaps in the coverage which may become evident close to the terminal.

Lateral separation will be the rule. It will be the aim to guarantee a clearance provided that the schedule is maintained. Although holding should only arise in an emergency, it may eventually be necessary to establish temporary alighting points at strategic locations beneath airways which lead into the larger cities.

By its contribution to safety, expedition and regularity, the Air Traffic Control Service, if organized in the right way, will play a vital part in the development of helicopter traffic on a large scale.

FOR ALPINE ATTACK

The P-16, by Switzerland's Fahr- und Flugzeugwerke A.G.

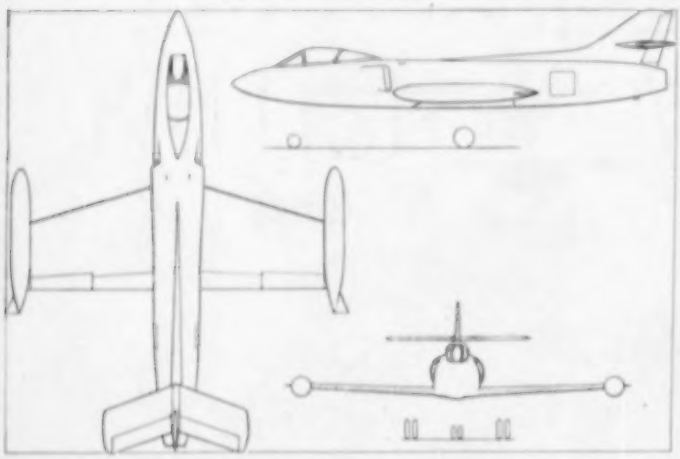
TEST flights of the first entirely Swiss jet aircraft, the F.F.A. P-16 attack fighter, powered with an Armstrong Siddeley Sapphire, have been interrupted by a slight accident. The brakes failed during a landing after a public demonstration on July 4th and the machine ran over a railway line, writing off the undercarriage. Repairs are expected to be completed shortly and flying will continue. A second prototype is scheduled for completion at the end of the year. The cause of the brake failure was the breaking of the hydraulic supply line close to the wheel by a stone thrown up from the runway.

Meanwhile some details of the P-16, specially designed for operations over Switzerland, are now available. First requirements were good climb and acceleration, coupled with the ability to lift heavy armament loads from the many small airfields tucked away in the narrow valleys of the Alps. This meant that exceptional slow-speed characteristics were needed, leading to some form of compromise between very high performance and tractability at low speeds. For this reason a thin, low aspect ratio (4·5) wing form with moderate leading-edge sweep-back (about 15 deg) was combined with drooping ailerons and high-lift devices which have been under development in Switzerland since 1947. Part of the considerably increased lift available for slow flying is provided by special flaps which extend over the whole span between the ailerons and under the fuselage. The tip-tanks act as end plates as well as having a structural function and are therefore not jettisonable.

Particular care has been taken over wing stiffness, and for this reason a special sandwich-type skin is used. The tip-tanks are divided into three compartments; they have a very thick skin and form part of the wing torsion box. While the flaps are of normal construction the ailerons are foam-filled in order to give the maximum stiffness with minimum weight.

The Dowty undercarriage has a reserve of strength in order to allow for possible increases in the all-up weight of later models. Each leg carries a pair of wheels with medium-pressure tyres for operation from grass fields. Brakes are hydraulic, with a pneumatic emergency standby. The main-unit legs retract inwards.

The fuselage is covered with fairly light-gauge skin, equivalent to the American 75 ST alloy, and the many cut-outs are heavily reinforced. Power is at present provided by a Sapphire ASSa.6, giving 7,900 lb thrust and weighing 2,640 lb. A fuselage break aft of the wing allows quick removal of the engine. Later versions of the aircraft may have reheat or a turbojet of higher power, but whichever unit is selected for production aircraft will probably be manufactured under licence by Sulzer Frères of Winterthur, who already produce the D.H. Ghost for Swiss Venoms.



The P-16 first flew on May 8th and is seen here being wheeled out onto the F.F.A. airfield at Altenrhein.

Horizontal tail surfaces have parallel chord and are more highly swept than the wing to give good control at the higher Mach numbers. The tailplane is variable in incidence through a hydraulic motor, with a mechanical standby, and is noteworthy because of the use (for the first time in Switzerland) of tapered-thickness skin over a multi-spar frame. All other flight controls are French Leduc-Jacottet units, specially designed to be accommodated in thin surfaces.

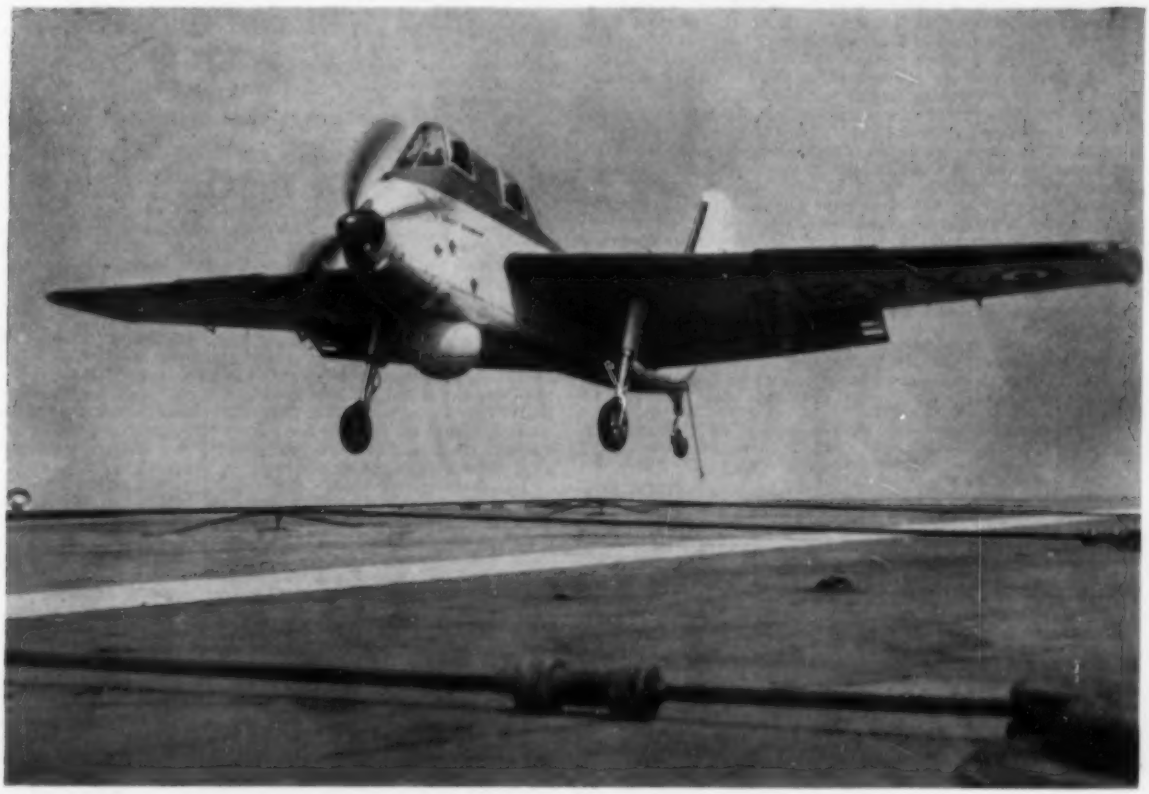
Hydraulic power is used for all services in addition to flight controls and a Dowty high-pressure system charged by an engine-driven pump is supplemented by accumulators which provide for emergency operation of undercarriage, air-brakes and flaps. A second standby is provided by a pneumatic system which can be used for wheel brakes, as stated above, undercarriage lowering and emergency hood-jettisoning. A compressor bleed, expansion turbine, thermostats and filters are used for cockpit pressurization and air-conditioning. Since no hydraulic lines may be led into the cockpit, for safety reasons, all hydraulic services are electrically controlled, and this is the primary function of the electrical system. The 24 V D.C. engine-driven generator in addition provides current for operation of engine starter, fuel pumps, windscreen heating, radio and radar. The latest U.H.F. equipment and an unspecified radar installation are catered for.

The P-16 is remarkable in its class for having a weapons bay in the fuselage centre-section, designed to accommodate rockets, fragmentation or napalm bombs or, for ferry purposes, a large extra fuel tank. This armament is supplemented by two 30 mm guns permanently mounted in the nose, and further armament may be carried under the wings. There are five fuel tanks, including those at the wing-tips, all of which can be rapidly replenished through a single nozzle.

No performance figures for the P-16 have yet been released. The main emphasis has evidently been on relatively high performance at low levels over a wide speed range, combined with good manœuvrability and the ability to fly very slowly. If the company has been successful in achieving this, the P-16 should be an excellent machine for ground attack in the mountainous regions of Switzerland.

SEAMEW ON THE DECK

THE official Admiralty photographs at the head and foot of this page show the second prototype of the Short Seamew A.S.1 light anti-submarine aircraft (Armstrong Siddeley Mamba) during acceptance trials aboard H.M.S. *Bulwark*. The third, smaller, view was recently secured at Belfast and shows the Seamew with wings folded and weapons-bay doors open. From the larger pictures it will be gathered that the rudder has lately been largely modified, having a horn balance, revised profile, and an extension of the inset tab into the lower portion.



JET ENGINE INTAKE DUCTS

Their Compatibility with Engine Compressors

ONE of the papers read at the fifth Anglo-American Aeronautical Conference, held in Los Angeles last month, was by Mr. J. S. Alford of the American General Electric Company. He dealt with various aspects of the effects of intake flow and velocity distortion on turbojet compressors.

The speaker began by saying that velocity distortion at the inlet to axial compressors had been found to have an adverse effect on the performance of some jet engines. In addition to the performance loss due to the reduction in average pressure recovery, the internal performance of the engine was reduced.

Inlet flow distortion caused stall to occur earlier in highly-loaded regions of the compressor, reducing the average pressure ratio at which the compressor surged. In addition to causing a reduction in acceleration margin, the distortion frequently resulted in an increase in vibratory stresses in the blading, and in some cases in an increase in maximum hot gas temperature at the turbine inlet. Jet engines varied substantially in toleration of inlet-flow distortion, both as regards magnitude and pattern of distortion. For example, some of them tolerated circumferential distortions better than radial distortions, while for others the reverse was true. Induction systems varied in pattern and magnitude of flow distortion at the compressor inlet. For instance, when one inlet duct supplied all the air for a single engine, the distortion pattern typically occurred only once in the complete circumference. When twin inlets supplied air to a single engine, the distortion pattern was usually repeated twice in the complete circumference. The pattern and magnitude of the distortion also varied substantially with flight Mach number, angles of pitch and yaw, and engine airflow.

Jet intakes had to operate over a relatively wide range of flight Mach numbers, angles of pitch and yaw, and air mass-flow. Off-design mass-flow ratio, and high angles of pitch or yaw caused flow-separation. Therefore, to increase the range of inlet duct flow parameters and angles over which stable and efficient operation must be provided would add to the difficulty of providing a uniform entry velocity to the compressor for all operating conditions. As an example of the wide range of flow parameter, the speaker said that the inlet mass-flow ratio, $W/\rho AV$ varied from infinity while stationary at sea-level, to less than unity in high-speed flight. If, at high supersonic speeds, the pilot should quickly throttle back and substantially reduce the engine air mass-flow, an instability known as "buzz" would occur in some intakes. The resulting large amplitude of pressure pulsation might be dangerous as well as creating an unstable transient operating condition.

Induction systems of both nacelle-type and buried installations had been studied for distortion patterns at the compressor inlet. The principal characteristics of the main types appeared to be the following:—

(1) Nacelle or nose intakes of various lengths. In the shortest ones, the centre "bullet" protruded ahead of the inlet lips.

(2) Twin side ducts with inlets in wing roots or in the sides of the fuselage. In order to assure substantially equal flow in each duct, the splitter vane separating the ducts must extend to within a few inches of the inlet blading of the compressor.

(3) Twin side ducts as above, but with each duct supplying all its air to a single engine. Large distortions often occurred with appreciable angle of yaw.

(4) Bottom inlets had good pressure recovery, and tolerated angles of pitch and yaw relatively well. One objection to the use of bottom inlets was their tendency to pick up foreign matter and pass it into the engine inlet.

The speaker next detailed five flow-distribution devices to improve flow uniformity in the annulus at the compressor face.

(1) A freely-rotating row of blades could, under certain conditions, be successfully applied to improve severe velocity gradients in an annulus. The free blade stage transferred energy from the regions of high axial velocity to those where the axial velocity was low.

(2) Although screens placed across the intake were effective in reducing distortion, the relatively large losses made screens a last-resort method of solving the problem.

(3) A diffuser followed by a rapid acceleration reduced the distortion at the compressor face. The effectiveness of this arrangement appeared partly to depend upon mixing. However, the diffusion process introduced additional losses. In addition, the space available for a diffuser was usually limited.

(4) If a more-or-less straight cylindrical section of duct were located ahead of the compressor face, the mixing in the duct would reduce the magnitude of the distortion. However, space available for large-diameter, straight cylindrical ducts was usually limited.

(5) Stationary mixing devices had been used to improve mixing where the axial length available was limited.

Mr. Alford went on to say that distinction should be made between a local stall and surge. Compressors did not necessarily surge when the breakdown usually called "stall" was reached. This breakdown was the discontinuity between two types of operation in which the "in stall" condition was one characterized by poor performance and the presence of severe rotating stalls, often single-sector. Surge was considered to be the process of passing into and out of the stalled condition.

It was most important to recognize that a particular distortion expressed in terms of total pressure would result in widely varying changes of velocity and aerodynamic blade loading over the required operating ranges of different turbojets. Flow distortion due to inlet struts and guide vanes, however, had a negligible effect on compressor performance. If the size of the loss area or "hole" in the inlet velocity pattern increased, a greater shift of flow was required to reach a uniform flow pattern in the compressor. Smoothing out of the velocity deficiency in these larger areas required airflow shifts over greater distances, and therefore more stages of the compressor would be affected.

Another factor arose when, due to the ram temperature rise at flight Mach number of 2.0, the engine operating at full mechanical speed would have a corrected speed of approximately 85 per cent. At a flight Mach number of 3.0, the corresponding corrected engine speed would be only about 70 per cent. At intermediate corrected engine speeds, the airflow capacity of a turbojet was definitely dependent on developing an adequate pressure rise through the front stages.

When the turbojet was limited to subsonic flight speeds, the principal requirement for the compressor stall line at intermediate engine speeds was that it should be sufficiently far above the steady-state engine operating line to provide satisfactory transient operation, such as in bursts of throttle, and adequate engine acceleration.

Variable inlet guide vanes had been used to eliminate compressor stall at low and intermediate engine speeds; but, where maximum thrust was required at high speeds, the inlet guide vanes were kept fully open in order to obtain the greatest air capacity. With variable inlet guide vanes, the blades could be closed down in order to accept poor inlet flow distribution at the expense of thrust—a flexibility probably not possible with other types of engines.

The lack of a practicable stall sensor which could be integrated with the engine controls had made it necessary to programme the excess fuel injected into the engine during alterations of power setting. From measurement of such quantities as the inlet-air temperature, compressor-discharge pressure and engine speed, a synthesizing process inside the fuel regulator determined the excess fuel injected during throttle alterations. In establishing the fixed fuel schedule in the regulator, combinations of all major facts which affected the location of the compressor-surge limit had to be taken into account.

There were many other factors which affected the margin of normal operating conditions over compressor stall levels, some due to engine design and others to manufacture. In the throttle system some allowance had to be made for variations in sensitivity, but more precise fuel metering would permit the allowance of additional margins for the effects of bad inlet-flow distortion. It could also favourably affect the engine's performance at the moment an afterburner was switched off.

This led to the problem of matching particular intakes with particular engines. Here full scale and model tests should be made on the ground, simulating the various effects which could be expected in flight, and assessing the engine's sensitivity to them. The speaker listed a series of total pressure profiles which had been tested in standard bellmouth intakes, by superimposing various configurations of screening over them. Flow-distortions of between 0.2 per cent and 30 per cent had been produced; Mr. Alford showed figures of many of the results. He concluded by urging airframe and engine manufacturers to improve the compatibility of inlet duct and engine by stressing (1) the design of inlets for good flow distribution, (2) development of flow distribution devices, (3) design of compressors to tolerate moderate (though not large) distortion, (4) provision of adequate margin in the engine cycle, (5) development of more accurate engine control and (6) the matching of inlet-duct flow-distribution to engine requirements.

[*Contd. on page 155*

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JET ENGINE INTAKE DUCTS . . .

Discussion

Mr. G. Manganiello (assistant director, Lewis Flight Propulsion Laboratory) stated that the seriousness of the problem had only recently been appreciated. High-pressure-recovery supersonic inlets had poor flow conditions, even under design conditions, but one required a reasonably uniform flow at the compressor face. There was no simple answer to the question "how far should one compromise engine performance?" One did not want to pay too much for a good stall margin. The adverse effects at low Reynolds numbers and at high altitude reduced the stall margins—in some engines, by a great deal.

Mr. F. B. Greatrex (chief installation engineer, Rolls-Royce) spoke of the support now being accorded to the achievement of good flow distribution as well as good pressure recovery. It was noted that the lecturer used pressure-distortion as a parameter, whereas Rolls-Royce preferred to use velocity-distortion. Using the ratio of maximum to mean velocity, a single number could describe the distortion over the whole operating range. He asked whether radial or circumferential distortion was harder on an engine; Rolls-Royce had found no great difference between the two types. Particular problems were raised by ground-running of supersonic aircraft, the sharp-lipped intakes of which were nothing like the bell-mouths which engine manufacturers liked.

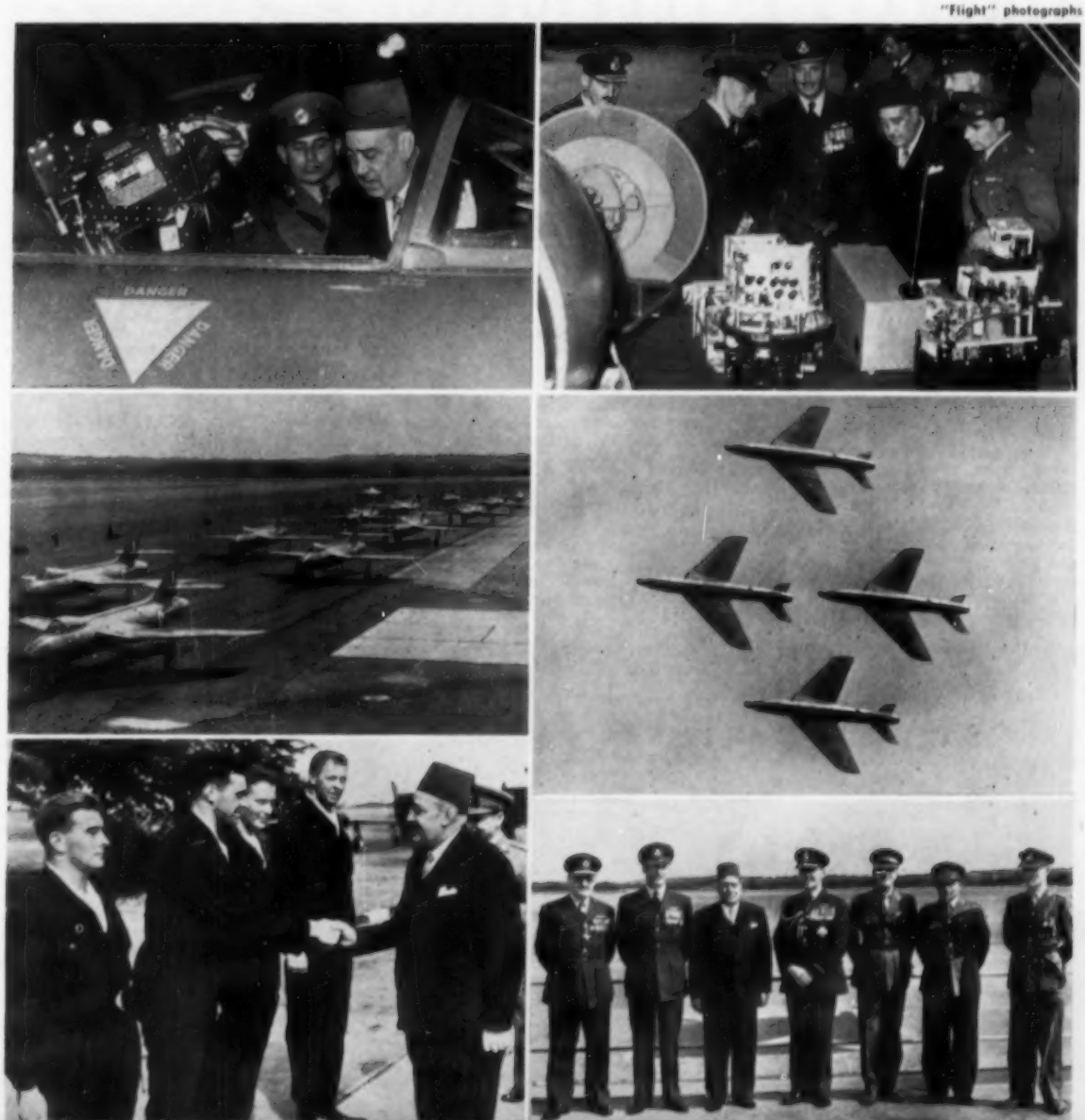
Mr. O'Donnell (Republic) said that there were many possible inlets for supersonic aircraft. Their design was, as yet, very empirical, and small changes could result in considerable alteration in performance. In designing, one had to suggest the distortion to be expected, and then attack the problem both ways, including rig simulation.

Mr. Alford, replying, agreed upon the advisability of rig simulation, including altitude simulation. Regarding the effect of types of distortion, the radial type had been found more adverse, particularly characterized by high losses at the blade tips. These results were, however, all obtained in tests and calculations on one particular type of engine.

LIBYAN DEFENCE MINISTER VISITS ODIHAM

ON Tuesday of last week Ibrahim Ben Shaaban, the Libyan Minister of Defence, visited R.A.F. Station Odiham. Accompanied by his Chief of Staff, Lt-Col. Idris Abdulla, he made a comprehensive tour of the station and watched a flying display put up by Nos. 46, 54 and 247 Squadrons. The two top photographs show the Minister inspecting the cockpit of a Hunter and having the mysteries of radar explained to him. The Hunter pictures in the centre illustrate No. 247 Squadron taxying out and the aerobatic team of No. 54 Squadron performing. At the bottom, the Minister is seen shaking hands with the 54 Squadron team—left to right, F/Os. C. J. Redhouse, B. J. Noble and P. Hamilton and Capt. R. G. Immig, U.S.A.F. (on exchange posting). In the official group are A.V-M H. L. Patch, G/C. A. K. Gatward, the Libyan Minister, Air Chief Marshal Sir Donald Hardman, Col. P. G. Wreford-Brown, Lt-Col. Idris Abdulla and Capt. R. M. Wade.

"Flight" photographs



The world's largest operational aircraft, the Convair XC-99, is portrayed on the occasion of carrying 212 cadets, from 28 colleges, from St. Antonio, Texas, to Fort Worth, for a tour of the Convair aircraft plant.

AIRCRAFT INTELLIGENCE

U.S.A.

McDonnell F-101 Development. Reference has been made in America to an intercepter version of the McDonnell F-101, at present the largest single-seat fighter in the world, and having a longer range than any comparable type. Whereas the existing machine has two Pratt and Whitney J57s, the intercepter would have the far more powerful J75s or Wright J67s.

Douglas B-66. Development troubles now engaging the attention of the Douglas B-66 team concern the hydraulic system and the tail turret. The former is said to have such feedback characteristics as to amplify normal vibration to the extent where flying characteristics are seriously affected, while the gun turret is causing buffeting.

Republic F-105. This fighter-bomber is said to have been designed for a Mach number superior to 2 and for a maximum range of over 2,000 miles. First machines of the type will have the Pratt and Whitney J57 turbojet, but production models are planned to take the larger J75. The initial order for F-105s is for 26 machines.

Beech/Morane-Saulnier Paris. The demonstration model of the Morane-Saulnier 760 Paris has carried the French Ambassador to the United States from Washington to New York in about 35 minutes. This represents an average speed of some 360 m.p.h. Cruising height was 14,000ft. Price in America is expected to be around $300,000.

Republic and the Caravelle. It is reported from America that at least one U.S. company — Republic Aviation — is showing interest in acquiring rights for the production under licence of the S.N.C.A.S.E.210 Caravelle.

All-magnesium Lockheed F-80C. An all-magnesium version of the Lockheed F-80C, built by the East Coast Aeronautics Corp. at Pelham Manor, N.Y., is now on test at the Wright Air Development Centre, Dayton, Ohio. Successful flight trials were normally made over Long Island. Development is said to have occupied a period of ten years, and the cost is put at $1,750,000.

Canada

Canadair Jet Trainer. An Italian source states that Canadair is designing a side-by-side, two-seat jet trainer for the R.C.A.F.

Italy

Frati F.10. In our previous issue we gave details of the F.8 Falco, designed by Stelio Frati, formerly chief engineer to the Caproni works. Now come preliminary particulars of the Frati F.10, a project for a light jet trainer resembling, in general layout, the Frati-designed Caproni tandem-seat F.5. The new machine will have side-by-side seating. The power plant is to be the Turboméca Marboré 2, the gross weight about 3,500 lb, and top speed, at 9,800ft, 298 m.p.h.

Germany

French Certifications. Airworthiness certificates have been granted by the German Aircraft Authority to four types of French aircraft, including the Jodel Bébé and D.11, a Druine and the Piel Emeraude. Drawings for the construction of these machines have already been converted to German standards. The Porsche company is known to be developing a 1.5 litre engine for some of these types.

Cambodia

Morane-Saulnier M.S.733. On April 20th the first three M.S.733 Alcyon three-seat trainers were delivered to the Cambodian Air Force, and since that time at least eighteen pilots have been trained on, and have gone solo on, these machines. A total of 250 flying hours and 954 landings were made before the aircraft were taken in for their first normal servicing. Four additional Alcyons arrived in Saigon on June 28th. These are equipped and armed for police duties and for gunnery training.

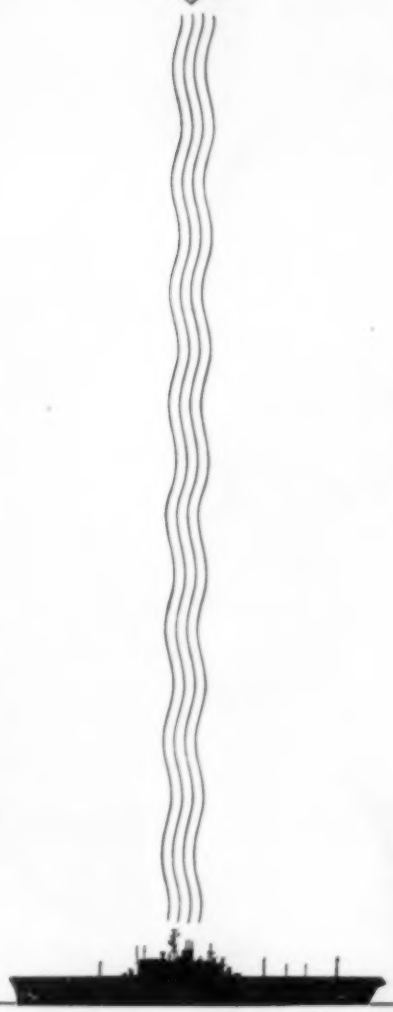
Three Ilyushin Il-14 transports form the background for this group of Russian leaders, seen during the playing of national anthems on their arrival at Cointrin Airport, Geneva.

Over seas oversea

in the line of duty

Fairey Gannets, now in H.M.S. *Eagle*, will be operating in training exercises over Mediterranean waters, where British sea power has so frequently been displayed in the past.

The Gannets thus take up another of their destined roles—guardians of the Fleet and the merchant ships against submarine attack. From carrier deck or shore base the "eyes of the Fleet" are flown confidently—the Double Mamba engine installed exclusively in this aircraft gives double assurance of operational efficiency and safety.



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First operator to use the DC-7B is PanAm. This is "Clipper Jupiter Rex."

The American Scene . . . 2

By THE TECHNICAL EDITOR

DOUGLAS at SANTA MONICA

A FAVOURITE statement in the advertising of the Douglas Aircraft Company is "more people fly Douglas than all other airliners combined." This claim, which refers to the scheduled air transport of the entire world, is undisputed; yet to retain it the California company must sell potential "seat-journeys" at a greater rate than all other transport manufacturers combined. On the face of things this would seem to be impossible; and yet Douglas are able to produce evidence which shows that, on the basis of present announced orders, they can actually improve their already overwhelming position *vis-à-vis* the world's other manufacturers of airliners.

Immediately after World War 2 something like 95 per cent of all the world's scheduled air transport was flown in aircraft of Douglas manufacture. At present the percentage is around 52, and such companies as Lockheed and Vickers-Armstrongs are turning out efficient transports as hard as possible; yet Douglas visualize a climb-back to a figure of 62 per cent by 1958. Some forty billion (American reckoning; i.e., 4×10^{10}) seat-miles are now becoming available each year, and the total available capacity is increasing at the rate of about 15 per cent per year (i.e., the air-transport industry is doubling itself every 6½ years).

It is now proposed briefly to review the present types of transport aircraft produced by Santa Monica, and a good starting-off point is to announce that the company is still in full production of spare parts for the DC-3. Regarding the perennial "DC-3 replacement" question, Douglas consider that the longer this is delayed, the less will be the need. As far as the United States is concerned, a progressively larger number of DC-6s and Convairs are pouring on to the second-hand market and these aircraft frequently suit the increased traffic of former operators of the DC-3.

At the time of our visit, the production state of the DC-6 series was: on order, 109, delivered 509. These figures refer strictly to commercial Sixes and take no account of the large number supplied to the U.S.A.F. and Navy for service with the Military Air Transport Service. The military versions correspond to the DC-6A, being specially equipped for freight-carrying, with a strong floor and large loading doors both fore and aft. These aircraft are still in full production, as also are commercial 6Bs, some for delivery as late as 1958.

The total of over 500 Sixes already delivered is impressive. The earliest machines are now eight years old and 80 per cent of the first batches have logged 20,000 to 25,000 hr apiece. Design cabin pressure-differential is 4.7 lb/sq in on the DC-6, and 5.2 on the 6B.

Probably the most important transport-manufacturing programme at present concerns the DC-7, the current position of which is: on order, 273; delivered, 65. Present production of the commercial DC-6 and 7 series is at the rate of 10 aircraft per month. This is four per month up on the average figure for 1954 and is expected to reach 13 per month by the end of the year.

As is now well known, the basic DC-7 differs from the 6B principally in being powered by Wright Turbo-Compound engines, initially with a maximum rating of 3,250 h.p. and with 1,800 h.p. promised for cruise (and actually used). Most DC-7s are currently certificated at 122,200 lb maximum weight.

The writer flew from New York to Los Angeles and back on non-stop coast-to-coast DC-7 services of United Airlines. Both the aircraft sampled are now about one year old and, although some passengers consider the noise up forward to be excessive, it was our personal opinion that the type can offer a very smooth and fast ride. We were frankly surprised to find that the brochure cruising speed of 365 m.p.h. (true air speed) is actually achieved towards the end of the journey; the let-down can be made at Mach 0.585 and the main units of the landing gear can be dropped at any indicated air speed to act as a ready control of drag.

There is at present no DC-7A and the next version is the 7B, fitted with so-called saddle tanks in the nacelles which provide an additional 810 U.S. gal of usable fuel. Tip tanks were considered (they are used on the later Constellations) but, both from the point of view of easing the run of the fuel system and reducing the compression taxying loads on the bottom of the wing, it was desired to keep the weight inboard. The added tankage takes the form of bag tanks housed in boxes made of titanium sheet in a fairly heavy gauge (about 0.08in). Titanium sheet has always been used for the main nacelle structure of all DC-7s (in spite of the cost, this is worth the weight of one passenger and his baggage throughout the life of the aircraft) and the saddle tank bays are fitted with smooth liners insulated by an airflow from the outside skin. The saddle tanks discharge into the main wing tankage and 15 min after taking off on the mains, the pilot would switch to the saddles and drain them.

Curiously enough, the revised form of the upper part of the nacelle has resulted in a cruising speed gain of some two m.p.h., although it is not proposed to make such a nacelle-form standard on the basic Seven. A further increase in cruising speed—and more efficient cooling—has also been achieved by fitting spinners to the four-blade airscrews. Much research has gone into the flow around the Turbo-Compound and the new spinners extend well back over the crank-case. Originally, a fixed fairing had been attached around the crank-case to continue the profile of the spinner rearwards, but no form of attachment could be developed capable of accepting the very high small-amplitude accelerations experienced by the engine.

At present 7Bs are being delivered to various airlines at a weight of 126,000 lb with DA-4 Turbo-Compounds giving rather higher performance (100 extra horse-power on most ratings except take-off). The new 7Bs for Eastern Airlines are particularly impressive, having the most lavish interior furnishing which we have yet seen on any standard fleet of airliners. Intended for such opulent routes as that between New York or Washington and Miami, the Eastern 7Bs will be known as Golden Falcons and gold is, in fact, the dominant colour of the interior.

In spite of the slight increase in gross weight (a matter of two

DOUGLAS AT SANTA MONICA . . .

short tons over that of the basic Seven) the 7B has a rather better take-off performance. During C.A.A. trials, a representative 7B established a full-load take-off field-length of 6,100ft, or 400ft better than the guaranteed figure. Corresponding landing field-length is set at 5,800ft (again better than guaranteed), in spite of the fact that the maximum landing-weight is now up to 102,000 lb. Zero-fuel weight is 96,000 lb.

This improved field performance, without any take-off power increase, has been achieved solely by revising the flap linkage. Through a relocation of the flap and its associated vane (which forms the double-slot) airflow characteristics and maximum lift coefficient have been improved. In addition to improving the weight/field-length characteristics the new flap also results in a significantly better second-segment climb.

Specifically intended for the longest airline stages, the DC-7C is still basically a Seven, the chief modification being an additional 10ft of wing centre section. Two-foot increments have also been added to each side of the tailplane and to the fin in order to counteract the effect of moving the engine thrust lines farther outboard. The engines themselves are EA-1 Turbo-Compounds which will provide no less than 3,400 take-off h.p. each. (Incidentally, the Turbo-Compound is probably the world's most expensive piston aero engine, with a first cost of at least $80,000 or £22,500.) In the 7C the engines will drive Hamilton Standard airscrews, each with four solid dural blades with a diameter of 14ft 6in more than that of the earlier Sevens. Nevertheless, the tip of the disc will lie 66in from the fuselage and, when coupled with unusually extensive sound-proofing, this should make the new transport the quietest piston-engined machine ever to enter service.

Douglas were lucky in that "Seven Seas" is a ready-made name for their longest-range product. The global ability of the new airliner stems largely from the increased wing span (of 127ft 6in) which not only improves the wing efficiency but also greatly increases the available tankage to 7,500 U.S. gal or 6,550 Imp. gal. Tankage occupies the entire volume of the wing between the spars and an accompanying photograph shows the author examining the inter-spar section of the wing of the first 7C. As the photograph shows, the broad centre section has no dihedral, and it also has a constant chord.

Most of the remainder of the 7C closely approximates to that of the Seven although the fuselage is 40in longer (112ft 3in) and can work at a pressure differential of 5.45 lb/sq in. All the windows are to be straight-edged, round-cornered assemblies of a Douglas pattern known as triple-anticoustic. Two panes, either of which can take the full pressure differential, are employed, together with an inner pane floating in rubber.

An extremely comprehensive programme of testing is scheduled for the DC-7C. There will be no prototype as such; the first aircraft will have no interior furnishings to start with but will later be sold. Somewhere in the programme a month of ground testing will have to be inserted. A probable schedule would be a first flight in December this year followed by one or two other flights to establish the basic handling and certain other factors. The aircraft would then be returned to a hangar at the company's Long Beach plant for vibration and other static testing. Considerable pressure-hull testing has already been done. The second machine should fly in February and the third the following month; C.A.A.-testing will certainly need three aircraft and possibly four, and Douglas expect to receive a licence in June 1956. It is worth noting, incidentally, that the use of the huge I.B.M. 701 computer installation is certain to save over one month in calculation time.

Construction of the first DC-7C Seven Seas is steadily progressing, and the extent of the wing span can be gathered from this photograph of the inter-spar sections and tank bays. The author (right) is being shown the new wing by Thoyle Taylor, DC-7C project engineer at Santa Monica.

Earlier this year, Douglas announced a million-dollar programme for the construction of additional plant—and rearrangement of existing floor-space—to facilitate DC-7C production. At present the erection of Sixes and Sevens completely fills the available space. In fact, the stretched fuselages even project into a recess in an outer door, and the considerable increase in size represented by the 7C would have been too much. Five new subsidiary buildings are being built, and much planning has preceded the decision to phase in many major components of the 7C to the existing assembly lines.

There was at one time a project for a turbine-driven DC-7D, although this is shelved at the moment. The 7C could, in fact, use more power with the same engine spacing but, were an R.B.109-powered machine to be developed, the outer engines would be moved two feet nearer to the wing tips.

Attention can now be turned to the recently-announced DC-8 jet transport. The basic configuration of this machine has already been widely publicized (*Flight*, June 17th, 1954) and it is, of course, the outcome of a truly tremendous programme of market research and engineering development.

Compared with the basically-similar Boeing model 707 (permission for Boeing to build a commercial airliner prototype was recently received from the U.S. Air Force), the DC-8 will have rather greater wing area and a lower angle of sweep. As a result the lift coefficient will be higher, and it is considered that the Douglas will be able to operate from any given runway at a considerably higher weight than will the Boeing, assuming that the power units in both aircraft will be the same. Owing to lower sweep angle, the Douglas will not require spoilers for adequate lateral control. The primary controls will be aerodynamically boosted, such an arrangement being adequate at least up to the design cruising Mach number. Actually, Douglas expect to have to incorporate powered controls for C.A.A. demonstrations at high Mach numbers. Once this series of trials is completed, the company will do everything possible to remove the powered controls and the production transport will probably be marketed with the aerodynamic-boost arrangement already noted.

The structure of the jet airliner is already almost completely designed and we saw a very considerable amount of constructional work in progress. Much of this was for test structures, although metal is already being cut for the first few aircraft. The wing, of 134ft 6in span, will be of a conventional three-spar pattern and Douglas emphasized that no wing member will be required to carry more than 10 per cent of the load.

The landing gear is particularly interesting and a detail sketch shows the form of main unit which has been designed. With a conventional two-by-two bogie, each main unit is prevented from pivoting about its own oleo but has to rotate about a vertical axis in space, with consequent disadvantageous effect upon ground manœuvring. Douglas have developed a main unit in which four wheels are mounted on a single axle, two on each side of the main oleo. The aircraft can pivot about the oleo itself without any tyre-scrubbing. As the sketch shows, the unit is so arranged that, as the main leg retracts inwards, the axle assembly turns to lie parallel to the longitudinal axis of the aircraft. This is achieved by splaying out the "Y-form" upper part of the leg in a fore-and-aft direction and canting the hinge axis diagonally across the wing; the axle does not actually turn in the leg. The wheels themselves are stowed in an unpressurized fuselage compartment beneath the centre wing and both gravity and airloads can be called upon to assist the unit in dropping and locking into position. A steerable nose undercarriage with twin wheels will be employed, fixed limits being imposed upon the steering angle.

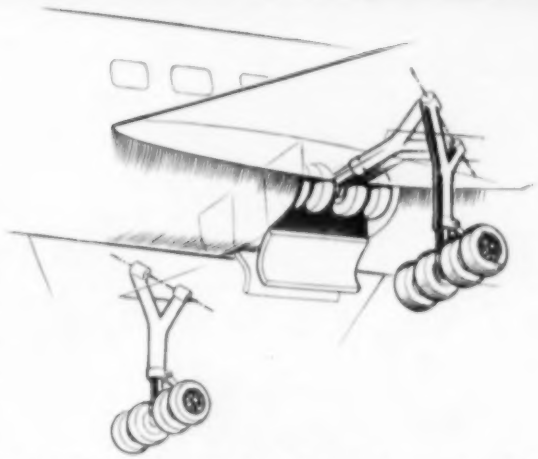
Multiple disc brakes will be employed together with an anti-skid system, and a drag parachute will also be fitted during the flight-testing programme. Although the main undercarriage units will be stressed for lowering at high indicated air speeds, the DC-8 will also be fitted with a powerful speed-brake for rapid deceleration and steep descent.

Two versions will be offered, a domestic machine at 211,000 lb and an international over-water machine at 257,000 lb. Weights of this nature will clearly demand four power units with a total thrust greater than 40,000 lb. An obvious possible contender is the Pratt and Whitney JT3L, a commercial development of the well-known J57 which is expected to achieve a commercial rating of about 11,000 lb.

It was recently announced that an engine as near as possible to the production JT3L has now been given a 1,000-hr static test, simulating operation on the New York to Los Angeles route with a stop at Chicago (this ties in with United Airlines' interest). The test was run in two equal periods, and less than 80 man-hours of maintenance are reported to have been required. Only one fault occurred: a plugged oil line to a main bearing at the 978-hour mark. Military J57s have completed accelerated service tests during which actual flight times of 500 hr have been logged without overhaul. At present it seems probable that 500 hr will, in fact, be the initial major-overhaul life set for the JT3L.

On the other hand, it is natural for Douglas to look towards more than one powerplant, and Mr. Edgar Burton, the Santa Monica division's chief engineer, expressed his company's very serious interest in the Rolls-Royce Conway. The optimum power for the DC-8 would seem to be of the order of 13,000 lb-thrust for take-off, and an extensive research programme is already well advanced in an attempt to find the best methods of reducing internal and external noise. Choice of fuel would be left to the operator, but it seems likely that wide-cut fuels would predominate in American operation of the DC-8. Most of the tankage is integral throughout the wing, although there are certain unspecified sections in which bags are used.

On all domestic routes other than the non-stop coast-to-coast sector, the operation would be determined by the landing weight. On paper the DC-8 is highly flexible in operation in that the performance does not significantly deteriorate at heights as low as 30,000ft and, on the other hand, a cruising height as high as 45,000ft can be selected if necessary. Various forms of interior layout have been planned, with four-, five- and six-abreast seating. Many operators have expressed a preference for a mixed cabin with first-class and coach passengers, and the maximum capacity in the coach configuration is 135 passengers. There is a lower "bubble" in the 140ft fuselage which houses no fuel but will be fully occupied by the various systems and the pressurized baggage holds. Douglas and other companies—such as Sperry—have evolved a radically new system of instrumentation in which data presentation is effected in a highly novel manner.



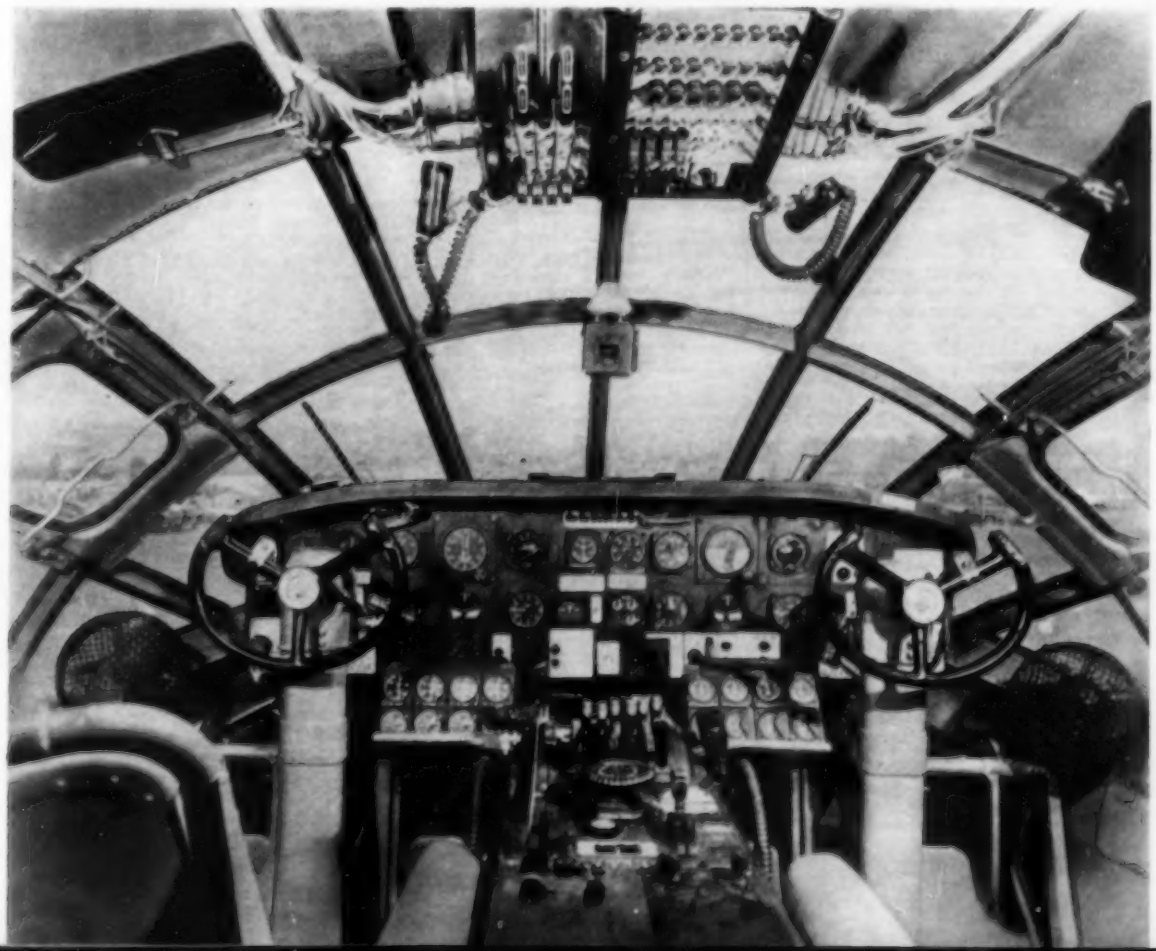
Finding the author's pencil sketch inadequate, our artist, Arthur Bowbeer, built a working model of the DC-8 main undercarriage in order to develop a geometry which operates as described in the text.

Douglas have not yet finally decided what sort of test programme will be carried out on the DC-8. We learned that they will certainly do tests of the pressure-hull using air as the pressurizing medium and filling the volume with ping-pong balls to reduce the stored energy. On the other hand, a large water tank is now being built at Long Beach (a structure 170ft long and costing $1,000,000) and it seems likely that the DC-8 will be subjected to "the full torture" just as our own transports have been. The fuselage will certainly be tested at 1g stress levels with full pressure and aerodynamic loads.

A first-flight date in November 1957 has been announced, with initial deliveries following about two years later.

ROOM WITH A VIEW—THE FLIGHT DECK OF THE B-36

There never was any other "office" quite like that of the Convair B-36, nor is one likely to materialize in the future. Certainly Convair's next bomber, the supersonic B-58, will be far less liberal in fenestration and in interior space; on the other hand, B-58 crews will never be airborne for longer than a very few hours, whereas B-36 captains keep calenders on the wall. They gain the flight deck via stairways from the nose, and walk round the outside of their seats—the space between the seats being filled by a massive control desk. At the front of this desk are the six throttles (too many for one hand), and four jet power levers lie up in the roof. It will also be noted that, in case the 150-tonner reaches a tropical clime, each pilot has a ventilating fan.



North side of Lasham from the air, showing glider hangar and trailer park, briefing tent (in front of clubhouse block) and camping area.

"FLIGHT" PHOTOGRAPHS

National Gliding

at Lasham: A Slow Start to the 1955 Championships

FROM a 200ft overcast sky, Lt-Cdr. M. H. Simpson, R.N., descended last Sunday by S-55 helicopter onto the carefully "H"-marked area opposite the Control tent at Lasham Aerodrome, to disappoint a large number of people. His flight had been made, not with the Duke of Edinburgh (who had planned to visit the National Gliding Championships on this first competition day) but merely with an extremely pertinent curiosity concerning the weather conditions on the Duke's proposed route. The bad visibility and low cloud-base (in places down to 50ft) over Hampshire satisfied his curiosity only too well, but caused little satisfaction among the hundreds of gliding enthusiasts competing, organizing and helping at the championships—the first to be held on a flat site since 1947.

The previous day, a firm, hot sun had shone, and Sir John Hunt had received his first two glider flights (both made with Derek Piggott, C.F.I. of the Surrey Gliding Club, in a T-21B), above and round Lasham. In between these flights, Sir John formally declared the championships open, and a large number of balloons (with free-flight vouchers attached) rose skyward together to mark the occasion. Many of the competing sailplanes, which had assembled at the Surrey club's Lasham site during the week, were rigged and made practice flights; the aero-towing system was transformed from lines sketched on a scrap of paper into the droning reality of Tiger Moths and Chipmunks; and final touches were added to the concentrated encampment of tents, trailers and caravans that had suddenly flourished on the Lasham wasteland.

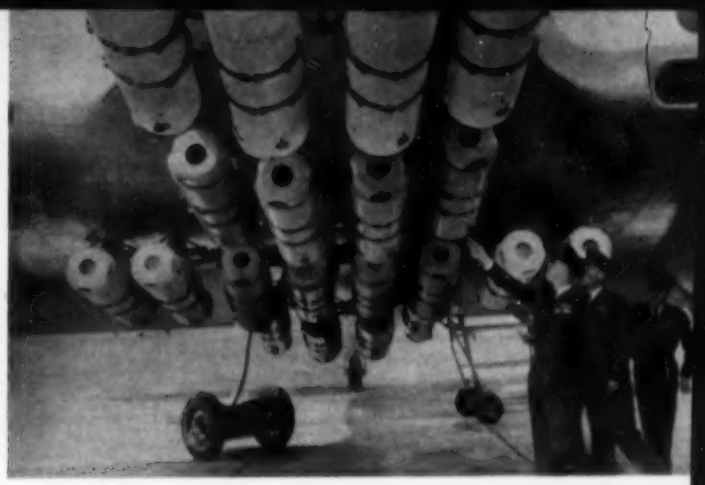
There were few last-minute alterations to the list of entries as printed in *Flight* a fortnight ago. Both of the new types—the Skylark III and the faired-canopy Olympia, had been completed in time, and the latter had been moved into the individual class. One Skylark II, instead of two, had been entered by the Army Gliding Club.

On Sunday morning, in spite of the low cloud and bad visibility, an improvement was forecast for the afternoon, and the task set for all classes was distance along a line from Lasham to Yeovil. Following the disappointment of the Duke's non-arrival, however, came the further frustrating news at 2.30 that, as the cloud-base had not risen to more than 600ft, contest flying for the day was cancelled. As the colourful lines of waiting sailplanes dispersed, ground and flight demonstrations by several types were laid on to claim the attention of the several hundred members of the public who were present—or those of them who were immune from the temptations of the full-scale fun-fair in the public enclosure. Not until 6.30 that evening did the cloud break up, leaving a wide blue sky and a sunny evening for some intensive circuits and aerobatics by T-21Bs and various single-seaters—a pleasant ending to a disappointing opening day.

Competition flying started on Monday, and Philip Wills took a provisional lead with a 109-mile (3 hr 13 min) flight to Exeter.

K. T. O.

Above, Sir John Hunt, Derek Piggott, Philip Wills and Ann Welch; below, the launching site; right, the modified Olympia entered by the R.A.F.G.S.A.



THE DUKE AT ABINGDON

LAST Friday the Duke of Edinburgh flew from Buckingham Palace in a Fleet Air Arm Whirlwind to R.A.F. Station, Abingdon, in Berkshire, to pay an informal visit to Transport Command units and to the Parachute Training School. On arrival he was received by Air Marshal Sir George Beamish, A.O.C-in-C. Transport Command, and inspected a guard of honour, as seen in the left-hand photograph above.

In the Parachute Training School, His Royal Highness watched paratroops exercising on the various synthetic devices used in their training. The two pictures below show the Duke, accompanied by Air Marshal Beamish, talking to a paratrooper wearing the full jumping equipment, and (on the right), watching Naval frogmen in waterproof suits and flippers working out on the harness-release trainer. The morning ended with a display of parachute jumping by R.A.F. instructors, four of whom made a delayed drop from a Valetta, while others jumped from a Hastings, and from a Tiger Moth belonging to No. 47 Squadron's flying club.

After lunch the Duke inspected a Hastings of No. 24 (Commonwealth) Sqn. fitted with heavy-beam dropping equipment for a jeep, limber and 75 mm gun (right), and another Hastings, from No. 47 Sqn., carrying 20 supply containers (top right). Thirty fully-equipped paratroops were also seen embarking in a Hastings of No. 1312 (Transport Support) Flight.

ARGONAUT ODYSSEY

Economics of a Famous B.O.A.C. Fleet

By E. T. HOUSE

THIS is the story of the Argonaut Fleet—22 aircraft of polyglot ancestry—and of the way their operations were developed in the five critical years during which B.O.A.C. first showed a profit.

With its airframe designed in California, fabricated in Montreal, and fitted with engines from Derby, the Argonaut (as B.O.A.C. type-named it) was the Canadair DC-4M. It was basically a DC-4, but with Rolls-Royce Merlin 626 engines plus certain features of the DC-6. A compact and workmanlike machine, it had pressurization to bring the basic fuselage up to date, and high-power engines that made its speed competitive with that of most other aircraft of that period.

At a time when the British aircraft industry had not fully emerged from its wartime chrysalis, the Argonaut was planned as a stop-gap to keep B.O.A.C. going while replacement British types were produced. This it has done in a thoroughly satisfactory manner; and it is to this aircraft that the Corporation owes a large part of its economic success during the last few years.

The fleet was officially ordered in September 1948 and delivery of the first aircraft was made in March 1949. The whole fleet of 22 was completed in November 1949. This lightning delivery, due as much to commercial acumen as to intrinsic production efficiency (although the latter was also of a high standard) set the tone for Argonaut operations from the beginning. Under the pressure of expanding sales requirements, and in the environment of a wide-spread and variegated route pattern, new methods of planning, maintenance and operations were introduced and developed. In particular, the use of "planned maintenance" was fully implemented for the first time, with remarkable results.

Utilization.—Fig. 1 shows the hours flown by the fleet in six-monthly periods over the five years 1950 to 1954 inclusive. Fig. 2 relates hours flown to fleet strength and gives the daily

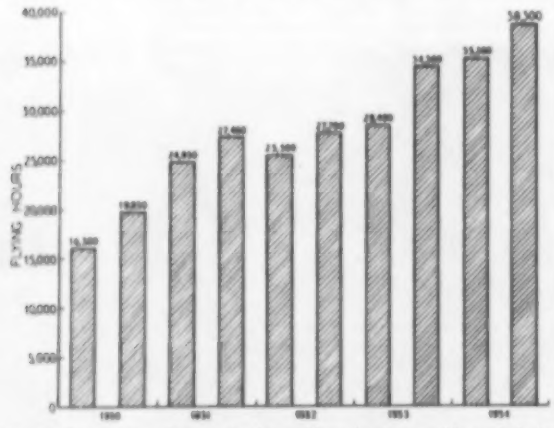


Fig. 1. Twenty-two Argonauts: hours flown in six-monthly periods for five years 1950-54.

hours flown per aircraft in January and July for each of the same five years. There is a typical increase in utilization during the first two years, a consolidation period for a year and a half, followed by further increases in 1953-4 and, finally, a rather dramatic rise in the last half of 1954.

The proportionate increase in utilization from between three

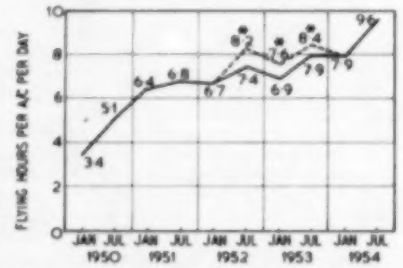


Fig. 2. Daily utilization of the 22 Argonauts in January and July during the period 1950-54.

*From Feb. 1952 to Aug. 1953 twenty-one aircraft only available for service at rate shown by dash line due to repairs to one aircraft.

and five hours in 1950 up to 9.6 hours in 1954 may be explained by significant and corresponding decreases largely in maintenance and overhaul. There was also some reduction in serviceable ground time by the cutting out of night stops and the reduction of overseas terminal turn-rounds. Nevertheless, the main improvement is due to the reduction of maintenance and overhaul time from around nine or ten hours per aircraft per day in 1950 to six or seven in 1954.

Engineering.—Improvement in engineering efficiency is more clearly shown in Fig. 3, which is a graph illustrating the standard of comparative overall engineering efficiency by relating the elapsed time spent on engineering to each flying hour. Thus the co-efficient is shown to have fallen from 2.25 in January 1950 to only 0.71 in July 1954.

Total engineering man-hours worked per week are illustrated in Fig. 4 and it will be seen that these follow the build-up of flying hours, although not in proportion, since Fig. 5 shows a small decreasing trend in man-hours per flying hour from about 23 to 21 over the five years. From these diagrams it will be seen that the main factor in the increase in Argonaut ultilization was the increase in intensity of the maintenance and overhaul work. More total man hours were worked in 1954 than in 1950, but in less elapsed time.

The associated background to this picture is given in Tables I, II and III, which show the development of flying hours between each engineering check, the accompanying decrease in elapsed time per check over the five years and the increase in engine hours between overhauls. Similar improvements in many component overhaul times could also be demonstrated. Associated with these improvements has been the need for intensifying the man-hours per elapsed engineering hour and of ensuring that a maximum of those man-hours are worked and not idle. This is no simple matter with 20 to 30 arrivals and departures weekly at the base, associated with five types of check and detailed shift systems. This is the triumph of "planned maintenance," by which is meant the precise application of man-power and material to clearly defined maintenance requirements.

On the overhaul side developments also took place. For the

TABLE I: HOURS BETWEEN CHECKS

	Check A	Check 1	Check 2	Check 3	Check 4
July 1950	35	50	110	220	440
March 1952 ...	38	80	160	320	1,230
April 1953 ...	50	100	180	350	1,250
August 1953 ...	50	100	180	350	1,400
April 1954 ...	50	100	200	360	1,400
December 1954 ...	50	110	200	360	1,400

TABLE II: SCHEDULED ELAPSED TIME PER MAINTENANCE CHECK

	Check A	Check 1	Check 2	Check 3	Check 4
1950	1½ days	1½ days	2 days	3½ days	7 days
1954	16 hr	24 hr	30 hr	50 hr	6 days

TABLE III: ENGINE HOURS BETWEEN OVERHAULS

1950	800
March 1951	900
September 1951	1,000
October 1953	1,250

first time the Certificate of Airworthiness was renewable over two years instead of one only. For this purpose, and because of the continuous utilization requirement, the C. of A. overhaul work was divided into eight groups to be spread over the two years, each part being done during an appropriate Check 4. This prevented duplication of work between Check 4s and overhaul and, at the same time, reduced specialized work on overhauls to a minimum. Component hours were matched to Check 4 hours so that, normally, component changes took place only on Check 4s, or occasionally on Check 3s. By this means the minor checks were kept free of more complicated matters, and detailed component-change programmes were worked out which ensured that no two C. of A. groups overlapped and enabled stocks for overhaul to be kept to an absolute minimum.

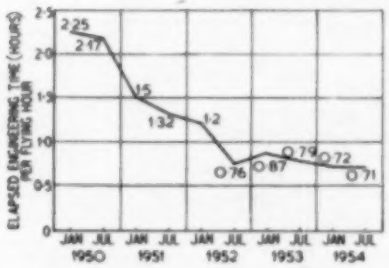


Fig 3. Co-efficient of engineering efficiency (elapsed engineering time per flying hour), January and July 1950-54.

Delays.—Fig. 6 shows the delay rate in hours per flying hour for the months of January and July in each of the five years under review. The total rate, given on the top line, is divided cumulatively into the main sections of "Mechanical," "Weather," "Traffic and Miscellaneous" and "Consequential" delays. These latter are partly the effect of other types of delay at overseas terminals, causing late initial departures homeward-bound, and partly their effect by causing unscheduled night-stops when a service has become a few hours behind schedule.

The overall trend is one of improvement as utilization increases. This is to some extent paradoxical, as the higher tempo of work with less time spent on maintenance and reduced traffic stops and turn-round times might reasonably be expected to have an adverse effect on delays. The facts prove the contrary. All types of delay, on the whole, show a tendency to improvement, although weather in January 1953 and mechanical delays in July and January 1953 and 1954 were against the trend. The figures given are, of course, only samples of two months in each year but they are, nevertheless, representative of the whole picture and were selected for that purpose.

The Aircraft.—The aircraft, as originally delivered in 1949, were straightforward 40-seaters, with two cargo holds underneath

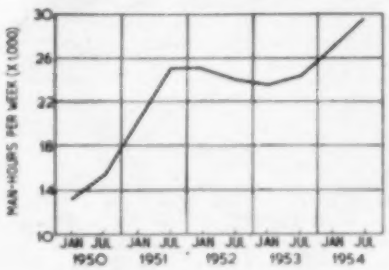


Fig. 4. Total engineering man-hours per week for 22 Argonauts (first week in January and July 1950-54).

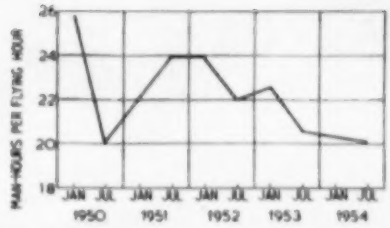


Fig. 5. Engineering man-hours per flying hour for the 22 Argonauts (first week in January and July 1950-54).

the fuselage, a third hold behind the control cabin, a lounge at the extreme rear and a mid-ships pantry. Opposite the pantry was a toilet and coat stowage and another toilet was forward of the passenger compartment, together with a ladies' powder-room. This remains the basic standard version today. The average aircraft empty weight in January 1950 was approx. 22,000 kg, but by the end of 1954 this had increased to 22,630 kg, the additional 630 kg representing a combination of the accumulated modifications of five years' intensive flying and the intrinsic heaviness of age.

Many of the modifications were for commercial development, such as the incorporation of cross-over exhausts during 1952-3 to reduce the cabin noise-level. Similarly, increases to maximum take-off and landing weight respectively from 36,378 kg and 31,751 kg to 37,195 kg and 32,659 kg took place in 1953 and improved the range/payload characteristics of the aircraft.

Changes in the interior layout were also made, for application as required. Freight bins were built to replace either the front four or front eight seats in the forward passenger cabin, reducing the total seating to 36 or 32 if cargo or mail loads were high on

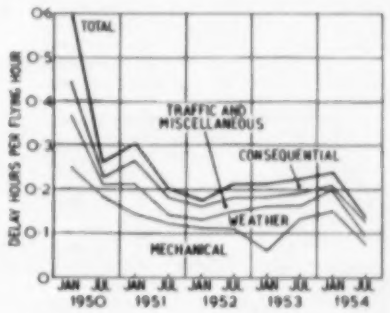


Fig. 6. Delay hours per flying hour (January and July 1950-54).

certain services. A quick-fitting freight floor for the main cabin was designed in 1951 to enable large cargoes to be carried when required, usually on charter work. A modification to the rear cabins of six aircraft was made in 1952, giving a standard V.I.P. arrangement of considerable comfort. (It will be recalled that an Argonaut brought the Queen back to this country from East Africa on the death of her father King George VI and, more recently, carried Her Majesty from Aden to Tobruk on her return from the royal Pacific tour.) Finally, between August 1952 and September 1953 the entire fleet was modified to permit a high density layout with 54 seats instead of the standard 40. With this new layout other changes were included. The midships toilet went forward; the ladies' boudoir became a freight hold; and the coat stowage and lounge disappeared.

All these alternative layouts, or combinations of them, can now be arranged at a few hours' notice. An Argonaut can return to base fitted with 36 standard seats and a freight bin in the cabin and leave again on a different route 12 hours later with a full high-density layout. A service may arrive at Hong Kong fitted with 32 seats and two cabin cargo bins, because of heavy outward mail loads, and leave the following morning for London with 40 seats. The cabin bins are capable of carrying the chairs (in a folded state) they replace, plus the full allowance of cargo (weight restricted structurally to 453 kg per bin); and, when the chairs are fitted, the bins can be folded and stowed in the main holds with a loss of only 82 kg per bin. Similarly, freight floor sections or V.I.P. fittings can be carried in the holds for fitting when required. Such arrangements make the Argonaut extraordinarily flexible from a commercial point of view, although more modern aircraft have improved schemes for interior layout changes. Table IV gives details of the principal alternatives on the Argonaut and the capacities thereby available; further permutations may be achieved by giving different standards in front and rear cabins.

The high-density modification permitted a wide selection of tourist services to begin operation, while the take-off/landing weight increases not only permitted fuller use of the high-density aircraft but improved payloads on long stages where fuel require-

ARGONAUT ODYSSEY . . .

TABLE IV: ALTERNATIVE INTERIOR LAYOUTS—CAPACITY AVAILABLE*

	kg.
Standard Seats	
40 seats	5,200
40 seats and 1 bin stowed	5,118
40 seats and 2 bins stowed	5,036
36 seats and 1 bin erected	5,361
36 seats, 1 bin erected and 4 chairs stowed	5,294
36 seats, 1 bin erected and 1 bin stowed	5,304
32 seats and 2 bins erected	5,522
32 seats, 2 bins erected and 4 chairs stowed	5,455
32 seats, 2 bins erected and 8 chairs stowed	5,388
High-density Seats	
54 seats	6,922
54 seats and 1 bin stowed	6,740
54 seats and 2 bins stowed	6,658
48 seats and 1 bin erected	6,837
48 seats, 1 bin erected and 1 bin stowed	6,780
48 seats, 1 bin erected and 6 chairs stowed	6,759
44 seats, 2 bins erected and 6 chairs stowed	6,920
44 seats, 2 bins erected and 10 chairs stowed	6,860
Complete cargo floor (including lashing points)	7,840

*Restricted by structure-weight or volume as applicable.

ments were high and on short stages where maximum landing weight imposed restrictions.

Performance.—The Argonaut is normally cruised at constant power of 950 b.h.p. per engine. This has been found in practice to be the most suitable method to preserve engine life and, at the same time, gives extra speed which is vital on many of the long routes. The effect on stage block times is given in Fig. 7, which shows the still-air block-speed for varying stage-lengths. A practical comparison with the Stratocruiser, the Constellation 749 and the lamented Comet I are included for interest. By far the majority of flights take place at or around 16,000ft, except where terrain, the shortness of the stage or weather impose different altitudes. Average fuel consumption under these conditions comes to just about 250 gal/hr for all operations combined.

A runway length of 4,800ft, with good approaches, will permit a full weight take-off in I.C.A.N. conditions at sea level with zero gradient, zero wind and a specific humidity of 1 per cent. This gives a clearance of 50ft at the end of the runway after a take-off run of 4,100ft. A temperature rise of 20 deg C (i.e., actual temperature 35 deg C), which is not uncommon, increases the runway requirement by 1,100ft to 5,900ft, so that the common runway length of about 6,000ft gives very satisfactory results. Many airports with runways of shorter length can still be used, particularly as the full take-off weight of 37,195 kg is needed only on the longer stages.

Timetables.—With the widespread route pattern that the Argonauts have flown throughout these five years, the timetables and overseas turn-round times have always been important factors in utilization control. They have also had a great effect on punctuality.

To some extent the Argonaut, as the ultimate development of the now obsolete DC-4, has had a hard time in the tough world of internationally competitive timetables. From the beginning of Argonaut operations the extra speed of the Constellation 749s (see Fig. 7) gave the latter a slight advantage. This lead was accentuated by the better range/payload ratio, which enabled the Constellation to overfly unwanted intermediate stations. More recently the DC-6 and -6B stiffened the competition, while in the last year the Constellation 1049 has shown its superiority.

Nevertheless, sales requirements for the Argonaut largely demanded fairly frequent stops; so, in many ways, its shortcomings were automatically nullified. Overall speed remained a problem particularly on the longer routes, such as London/Hong Kong.

From about 1950, the tendency of world timetables was, in the main, for flights continuously from terminal to terminal, landing only for refuelling and load changes. Many stations, of which Hong Kong is a typical example, completely forbade all night operations. Yet an arrival at Hong Kong four or five hours before sunset—a reasonable but not large margin on a flight of such length—implied an unpleasant departure time from London in the small hours of the morning. Overcoming this by the removal of transit stops would have caused loss of revenue from cancelled pick-up points or reduction in capacity by increases in stage-length.

In the south-west monsoon season, problems exist in night flying between Delhi and Bangkok; and, in the northern winter, morning fog at all stations from Karachi to Bangkok presents difficulty and is, at the very least, detrimental to an acceptable standard of punctuality.

For the first three or four years this problem was overcome by night-stopping outward-bound at Rangoon, putting an extra 16 to 18 hours on the elapsed time London/Hong Kong. During 1954, however, demands for speed for mail purposes, and the competitive schedules from other airlines with faster and longer-range aircraft, caused through London/Hong Kong operations to be scheduled—with, on the whole, acceptable results. A three- or four-hour delay between London and Bangkok unfortunately

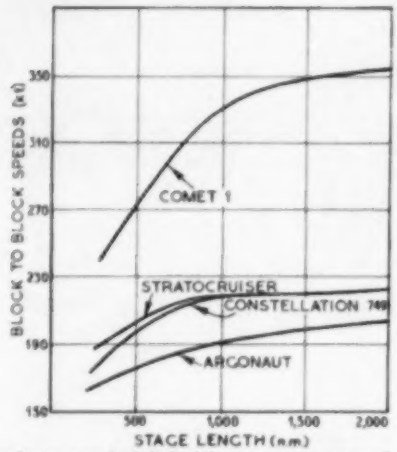


Fig. 7. Comparative block-to-block speeds, still air.

automatically results in an unscheduled night-stop at or west of Bangkok; but the incidence of such stops has been low. This is typical of the many and varied problems associated with long-distance air transport timetables.

Table V refers to Argonaut timetables in December 1954 and from this it will be seen that the number of night-stops were then very few indeed, while overseas turn-rounds were reduced to a few hours except where special reasons, such as crew rest on a low-frequency service, made a terminal night-stop the most economical method.

TABLE V: ARGONAUT TIMETABLES—DECEMBER 1954

Route	Frequency per week	Route Night-stops	Overseas Terminal Time
London/Accra or Lagos	7	Nil	2½/4½ hr
London/Nairobi	5	Nil	2 hr
London/Dar-es-Salaam	1	Nil	1 night
London/Johannesburg	3	Nil	1 night
London/Aden	1	Nil	1½ hr
London/Lod	1	Nil	2 hr
London/Tripoli (Leb)	1	Nil	1½ hr
London/Bahrain (a)	2	Nil	4 hr
(b)	1	Nil	1 night
London/Singapore (a)	1	Nil	1 night
(b)	2	1 each way	1 night
London/Tokyo			
(a) via Singapore	1	3 out, 2 home	1 day
(b) via Calcutta	2	1 out, nil home	1 day

When originally started, all West African, East African, Bahrain, Lod and Aden services used to have at least a night-stop at the overseas terminal. Such quick turn-rounds as are now shown can be scheduled only with a high standard of overall punctuality; and that of the Argonaut is adequate for the purpose.

Aircraft Roster.—The aircraft roster is a combination of timetables and maintenance time and is a diagrammatic representation of the complete operation which can be used for a variety of purposes. The actual roster is too complicated for reproduction; but the arithmetical breakdown, which always accompanies it and is used for cross-check purposes, is given below for the period December 1954 to March 1955:—

Flying hours:—	
Service	76,024
Crew checks	510
Total annual rate	76,534
Aircraft utilization (22 aircraft):—	hr
Per aircraft per annum	3,479
Per aircraft per day	9.5

Details of Maintenance Checks.—Checks 4: 56 per annum at 1,366 flying hours average (max. permissible 1,400). Checks 3: 168 per annum at 342 flying hours average (max. permissible 360). Checks 2: 224 per annum at 171 flying hours average (max. permissible 200). Checks 1: 560 per annum (max. permissible 100). Checks A: 616 per annum (max. permissible 50).

In practice the above checks are scheduled on a weekly basis applied to 52 Check 4s per annum. The outstanding four Check 4s, 12 Check 3s, 16 Check 2s, 40 Check 1s and 44 Check As are dealt with as an additional requirement. The minor checks present no difficulty. The extra 4s and 3s, however, create a problem in that one Check 4 shift only is maintained. Every 13 weeks, therefore, when a double Check 4 arises, the major check programme, including the extras, is intensified over several weeks.

Required Maintenance Time.—Aircraft are required at base for checks in each seven-day Check 4 cycle as follows:—

	hr
One Check 4, requiring 144 hr elapsed	144
Three Check 3s, each requiring 50 hr elapsed	150
Four Check 2s, 30 hr elapsed	120
Ten Check 1s, 24 hr elapsed	240
Eleven Check As, 16 hr elapsed	176
Time to cover delays, etc.	204
Total elapsed aircraft base hours required per 7 days	1,034

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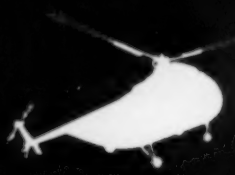

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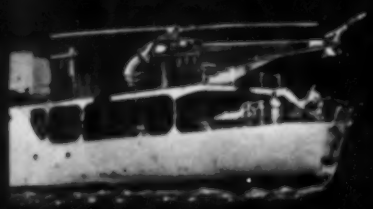

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ARGONAUT ODYSSEY . . .

Available Maintenance Time.—This is extracted from actual timetable arrival and departure times and gives the following aircraft hours available at base:—

	hr	min
Check 4 aircraft arriving base on Sunday ...	153	35
Checks 3 and 2 aircraft arriving base on Sunday	46	55
" " " " " " " Monday	51	00
" " " " " " " Tuesday	25	05
" " " " " " " Wednesday	44	35
" " " " " " " Thursday	56	00
" " " " " " " Friday	59	15
" " " " " " " Saturday	56	10
Checks 1 and A aircraft—total base hours ...	806	55
Total	1,299	30
Less hours for towing, loading and unloading at base at 4 hours per movement	116	00
Total aircraft maintenance hours available per 7 days	1,183	30

By deducting the required base time from the available time there is given a surplus of 149 hr 30 min weekly, equivalent to six aircraft days. Of these, two are required each week for crew check flights and the remaining four are used as required: (a) For sale for extra services or charters; (b) to cover delay peaks; and (c) to cover the extra check sequences each side of the double Check 4.

Perhaps the most significant feature of all this is the presentation of intensive activity when it is considered that it represents a continuous operation going on day and night for months and years.

Crews.—The normal crew of an Argonaut numbers seven, consisting of captain, first officer, navigating officer, radio officer, two stewards and one stewardess. For high-density seating arrangements it was for some time reduced to only six by the removal of one steward, but now the three catering staff are carried on both types of service.

Because of the lack of night-stops and the quick overseas turnrounds, combined with the Corporation's general policy of keeping crews centrally based in England, the Argonaut crew roster has resulted in an intensive use of slip crews. This means that about one-third of the total number of crews required wait at slip stations overseas for the next service to arrive so that they may take it on to the next slip station. Thus, in rotation, each crew works its way round the routes, taking sometimes as long as three weeks to get to Tokyo and back, while the aircraft do the same thing in as little as seven days.

Control factors used consist of: (a) crew elapsed working day from first take-off to last touch-down; (b) effect on (a) of leaving first stop at different times of day or night; (c) effect on (a) of operations on particular routes using specific stations and general conditions of weather, terrain, aids to navigation and general density; (d) an allowance of free time at home after each trip, roughly proportionate to the time away; (e) a maximum of 1,000 hours' flying each year (this is contractual); (f) a maximum of 125 hours' flying in any consecutive 30 days (this is mandatory); (g) minimum night-stop times of 12 hours; (h) minimum slip time of 24 hours except in exceptional circumstances where a slightly lower figure might be generally more acceptable; (i) availability of suitable night-stop and slip accommodation.

Financial Aspects.—Throughout its working life the Argonaut has been the general workhorse of B.O.A.C. Its rôle has been largely to lay the solid foundation on which profits could be built by absorbing the large overheads concomitant with the Corporation's vast route-spread. When times became difficult (e.g., when the Hermes proved expensive to operate or when the Comet was withdrawn from service) the Argonaut was expected to become not only the base but also a main part of the operation itself. On the Eastern and African routes there was no other aircraft in service to bear the burden except the L.749 flying to Australia, and this called at only seven stations out of a total of 43 used by the Argonaut. As a result of this, the allocation of overheads to the Argonauts, as compared with direct or variable costs, has always been high.

Table VI shows the total Corporation profits or losses before interest for the five years ending in March from 1950 to 1954. They do not, unfortunately, coincide exactly with the technical figures, as the latter relate to calendar years. It will be seen that once the Argonaut Fleet achieved a utilization rate of about 6½ hours per aircraft per day, the Corporation started to make a profit and has continued to do so to this date.

TABLE VI: B.O.A.C. PROFIT AND LOSSES (BEFORE INTEREST)

	1949-50	1950-1	1951-2	1952-3	1953-4
Total Corporation profits or losses*	£6,901,032*	£3,590,521*	£1,233,722	£103,875	£2,012,792
Total Corporation revenue	N/A	£24,252,115	£33,567,862	£36,156,579	£38,161,337
Total Argonaut revenue	N/A	£6,997,000	£10,270,000	£10,385,863	£12,453,452
Proportion of Argonaut revenue to total revenue	—	29 per cent	31 per cent	29 per cent	32 per cent

From 1952 onwards increasing proportions of Argonaut services were allocated to tourist traffic, and this resulted to some extent in a reduction in revenue per c.t.m. produced in the last year. In this last year it also became possible to show savings associated with the actual bulk of production, i.e., high utilization began to have a direct effect. Thus in 1953-4 the variable and fixed costs per hour both dropped 8 per cent as compared with 1952-3, and this trend continued to the end of 1954 following the further increases in utilization shown.

The Argonaut Fleet is scheduled to continue operations at full pressure of some seventy to eighty thousand hours a year until the spring of next year. By then it is hoped the Britannias will start to relieve the stop-gap aircraft of its burden. By 1957 the Argonaut may no longer carry the B.O.A.C. colours (except, perhaps, for freight purposes, instead of the York) and, after nearly eight years with the Corporation, the main Fleet will pass into other hands. There should be many years of service left in these grand aircraft and, at the likely disposal price, they should be profitable years on routes where the fierce glare of international competition can be avoided. The good wishes of a grateful Corporation should go with them.

PREPARATION FOR TRANSPORT-LICENCE EXAMINATIONS

"The Self Examining Handbook for Pilots and Navigators" (second edition) by E. Brook Williams and C. W. Roberts. Illustrated. Price 25s. International Aeradio, Ltd., Hayes Road, Southall, Middlesex.

THIS is the second edition of a work which occupies a senior place in the array of literature available to the candidate for the M.T.C.A. professional Pilots' and Navigators' Licences. The utility of the layout is to be commended, and the student for the Commercial, Senior Commercial and Airline Transport Pilots' Licences, as well as the man working for the Flight Navigator's Licence, will find that this book is what he has been looking for. In the first part of the handbook, questions are split into the relevant examination headings and the second contains representative examination papers at all standards; thus, the book provides some useful revision for the more advanced student as well as complete coverage for the junior licences.

Presentation of text, weather maps, graphs and tables is up to I.A.L.'s usual standard—and it may be added that there are few publications clearer in layout or print than those which this company produce for the professional airman today. The index is equally clear and informative, and should be *used*, unlike most indices in this class of book, which merely tend to camouflage the contents, and which in consequence are studiously ignored.

The main purpose of this book is to provide the student who is working in spare time without supervision some means of assessing the standard of his knowledge with relation to the Ministry requirements. The attempting of past papers, as published by H.M. Stationery Office, is always unsatisfactory, as the answers are never published as well. International Aeradio's handbook gives answers to approximately half the questions given in both parts. Where the question has no numerical answer, and the reply would need considerable space, it has been left unanswered. The preface recommends the student to attempt these questions, and to refer to a standard textbook for a satisfactory check. This is necessary to limit the book to its present handy size—more than 322 pages might prove unwieldy—but the reviewer feels that a supplement with model answers to the unanswered questions would provide an extremely handy reference book.

Finally, it is unfortunate that the syllabus for the examinations in question will be changed with effect from August 1st, 1955, although the great majority of the material in this book will never date. The new examinations will have their emphasis more towards "Items which pilots or navigators should know and be able to do correctly without hesitation, and to delete subject matter having little direct application to present day methods." A third edition will doubtless appear, and for the record should amend reference to the Air Navigation Order 1949 and the Air Navigation Regulations 1949, to refer to the current legislation issued during 1954. P.D.

THE ROYAL HERON

THESE newest pictures of the de Havilland Heron Series 2 which lately replaced a Vickers Viking of the Queen's Flight and which is frequently used, and flown, by H.R.H. the Duke of Edinburgh, are the work of Russell Adams. The pilot of the Heron was S/L. Caryl Gordon, the Duke's personal flying instructor. It will be seen that the aircraft now carries its Service number—XH375—whereas former pictures showed it with the makers' experimental designation G-5-7. The Heron is equipped to carry six passengers and three crew. It is powered with D.H. Gipsy Queen 30 Mk 2 engines, driving D.H. two-blade constant-speed airscrews and has exceptionally comprehensive radio.

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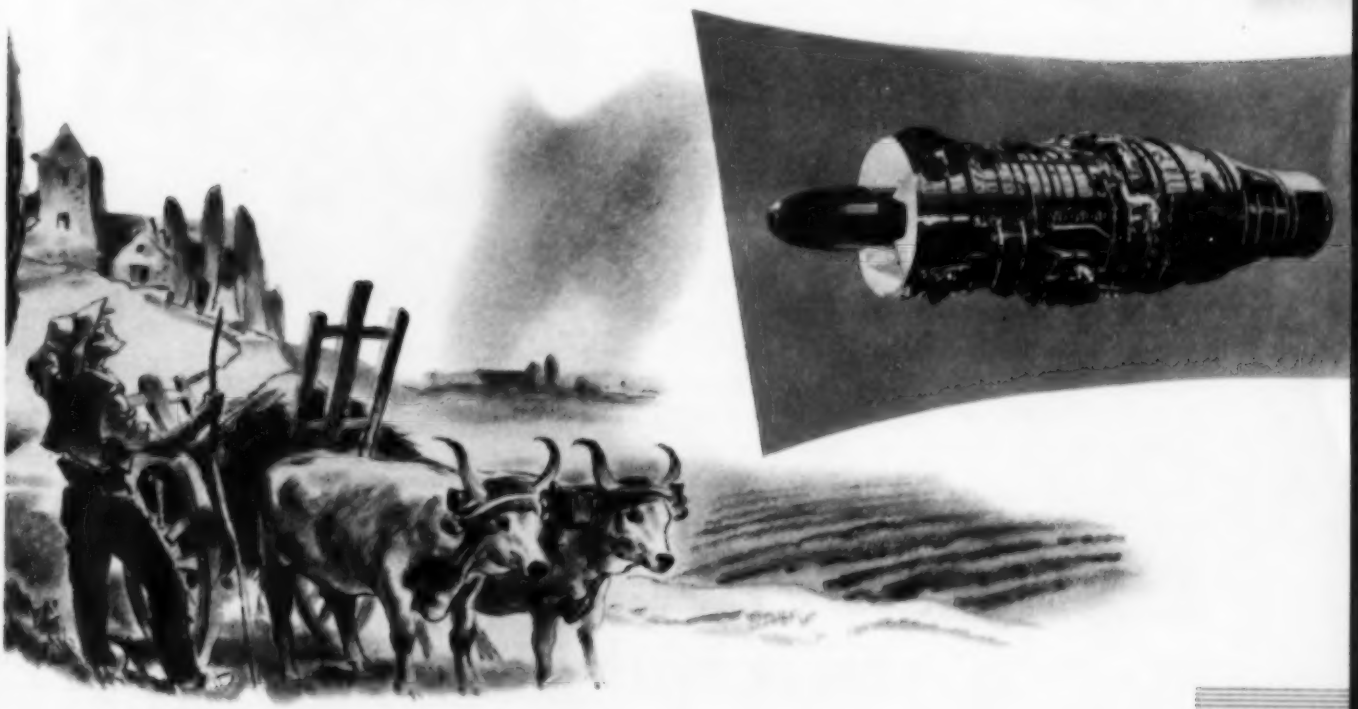

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TITANIUM in AIRCRAFT

THE reduction of titanium ores to metal and its subsequent melting present extremely difficult and complex technical problems. The root of the trouble is that titanium is extremely sensitive to impurities, nearly all of which affect its properties and behaviour. The melting point is some 200 deg C above that of steel, and the molten metal attacks all normal refractories. Molten titanium will absorb oxygen and nitrogen from the atmosphere, and both these impurities affect the properties of the metal.

Some two years before the outbreak of the second world war, Dr. W. J. Kroll solved the problem of preparing reasonably pure titanium in sufficient quantities to be useful. Apprehensive of the growth of Nazi Germany, he closed his laboratory in Luxemburg and brought samples of titanium to Britain in 1939. At that period, however, Britain was too pre-occupied with rearmament to be actively interested in the long-term prospects of a new metal. Dr. Kroll therefore went to the United States and showed his samples to many firms, but no company would take the risk of developing his process. The United States Bureau of Mines gave him the opportunity he sought, and in 1946 the announcement was made that the process had proved successful.

Though it was only in 1948 that metallic titanium was first produced commercially, it is already being widely hailed as the "wonder metal." Last year more than 5,000 tons of commercially pure sponge titanium were produced in the United States. The expansion programme sponsored by the U.S. Government aims at an annual output of 35,000 short tons by 1957. Yet even this ambitious target has been described as totally inadequate by U.S. Air Force experts, who claim that to keep pace with aircraft development an annual production of at least 150,000 tons will be required within the next five years. Though Britain lags behind the United States in the production of titanium, the metal is now being prepared on a pilot-plant scale and an establishment capable of producing 1,500 tons of sponge titanium a year will shortly be in operation.

Despite this rapid progress, it may well be many years before titanium becomes as familiar a metal as aluminium is today. When aluminium was first made about a century ago, it was sold at £54 a pound. Though the problem of cheap production was solved some seventy years ago, this metal was still in its industrial infancy when the first world war broke out. In view of the immense scientific and technological resources at the disposal of modern industry, titanium's progress might well be more rapid than that of its predecessors, aluminium and magnesium, but the production on a really substantial scale is still some distance off.

The future of metallic titanium depends on the cheapness with which it can be prepared and on the accuracy with which alloys with desirable properties can be reproduced. Higher outputs should have a favourable effect on manufacturing costs, but the root causes of titanium's high cost are the difficulties inherent in existing processes, none of which is really suitable for large-scale production. The reduction and casting processes must be carried out in a complete vacuum, and very special melting techniques must be adopted. The processes used involve heavy capital investment and high operating costs. Throughout the world a search is in progress for alternative processes that will make titanium really cheap.

The price of first-grade sponge metal has recently been reduced from five dollars to four dollars a pound, but it will have to fall very steeply before titanium can compete with other structural materials. Meanwhile the use of titanium sheet in aircraft production is confined to highly specialised applications where the increased cost is justified by the technical gains.

According to General Metzger, Chief of the Production and Resources Division of the U.S. Air Force and Director of the Aircraft Production Resources Agency, the use of titanium in commercial planes could increase the payload up to 30 per cent. or more. To military aircraft the favourable strength/weight ratio at elevated temperatures is very attractive. As an example, General Metzger instanced a four-engined combat aircraft flying today, in which engineering design coupled with the use of titanium could lead to a saving of 500 lb. per engine. Roughly, this saving could increase the speed 15 knots or its range by 100 miles.

Had it been possible to make use of titanium when the aircraft was designed, a far greater saving could have been made, because the rule of thumb in aircraft manufacture is that 1 lb of dead-weight removed from an aircraft permits a reduction of 10 lb of structural weight in design. It takes about five years from the drawing board to the production of a heavy bomber, so that when the aircraft above was designed, titanium was in its infancy.

Apart from the high strength/weight ratio, the properties of titanium that appeal most to the aircraft industry are heat resistance, corrosion resistance, and ability to retain strength at elevated temperatures. Under existing price conditions, titanium is not strong enough to displace aluminium on a strength/weight ratio basis, while no titanium alloy at present available can withstand very high temperatures. For temperatures between 250 deg F and 800 deg F, either titanium or stainless steel could be employed, but above the latter temperature it is necessary to revert to stainless steels, despite their greater weight.

Senator Malone, chairman of the Committee on Interior and Insular Affairs, United States Senate, presided over an inquiry into the titanium situation in the United States, which was held in 1953/54 and was concerned mainly with the requirements of the aircraft industries.

In his opening address Senator Malone described titanium as a "must" for air power in the future. He stated that its use in high subsonic and supersonic aircraft was essential and that there was no other known metal so uniquely fitted for the construction of a major part of airframes and engines. This view was supported by much of the evidence given by leading aircraft manufacturers.

The North American Aviation Corporation uses titanium in both the F-86 and F-100. In the F-86 the quantity used is equivalent to approximately 1 per cent of the aircraft, measured by weight. In the F-86H, a major redesign of the same aircraft, the percentage has been roughly doubled. The F-100, now being built in large numbers, incorporates 5 per cent of titanium in the finished aircraft weight.

Mr. William J. O'Donnell, chief development engineer of the Republic Aviation Corporation, has stated that, without much change in production, a saving of some 50 lb could be effected in the F-84 by the use of titanium, and this saving could be converted into additional external loads. In the case of aircraft to replace the F-84F, it is planned to use approximately 400 lb of titanium, representing a saving of about 60 lb, compared with the weight of the equivalent quantity of stainless steel.

This company has been experimenting with titanium and its alloys since 1951 and is confident that a complete aircraft could be made from titanium if the need arose. Flying at Mach 2 above 35,000ft (about 1,350 m.p.h.), the skin temperature of an aircraft would be approximately 250 deg F, and at this point the use of titanium could result in very large savings in weight.

Despite the high cost of the metal, about 200 lb of titanium is being used by Douglas Aircraft in the production of a new commercial transport, the DC-7C. The use of titanium for certain applications in the engine nacelles, firewall, and elsewhere is reducing the weight of the aircraft by the equivalent of almost 1½ passengers. By 1957, the company expect to be making structures 20 per cent (by weight) of titanium alloys.

The Lockheed Aircraft Corporation claim to have been among the first companies—if not the first—to build and fly an aircraft having titanium components in the structure. The company holds that the extent of titanium usage will be controlled by the effect on cost per weight empty and on cost per pound of disposable load. If the average cost of the raw material could be brought down to two dollars per lb—half the present price—titanium would compete with stainless steel and might be used for about 21 per cent (by weight) of the aircraft. If and when titanium alloys are reduced to 40 cents per lb, they will probably be used for some 40 per cent of aircraft weight.

Lockheed's own requirements of titanium in 1955 were reported to be 76 tons, compared with 31 tons last year. If the price were reduced by 25 per cent, this company would probably double its present rate of consumption in a very short time. The Committee was informed that engine manufacturers could use 50,000 tons of titanium in 1955, if it were available, plus an additional 50,000 tons in each successive year thereafter until minimum requirements of 250,000 tons per year were satisfied. Military requirements for 1956 are estimated at 35,000 tons.

In the absence of any radical transformation in production methods, only minor price reductions are expected during the next three or four years. Mr. Rex R. Lloyd, Branch Chief of the Bureau of Mines, Boulder City, N.Y., states, however, that a selling price of $3 per lb is not out of the question as improvements are effected in the Kroll process. Recent technical developments suggest the possibility of entirely new processes by which metallic titanuim could be produced more cheaply, but it has been predicted that, due to handling and extraction difficulties, titanium will never become a low-cost material.

Apart from price, there are several difficult problems to be solved before titanium can be regarded as a firmly established material for aircraft production. In the first place, users in the United States complain that the quality of titanium sponge is not yet sufficiently uniform and that alloys are often unsatisfactory for the end use. These difficulties are common to the development of any new material.

A second deterrent is the lack of processing and fabricating "know-how." The aeronautical industry is still learning how to make the best use of titanium, how to process it, and for what applications it can safely be employed. A.G.T.

ANALOGUE COMPUTATION

Its Place in Aircraft Design

By J. J. FOODY, M.Sc.*

ANALOGUE computation is not by any means new to the aircraft designer; his well-tried analogue, the slide-rule, has been his ready assistant in a heterogeneous miscellany of casual calculation and will continue as an irreplaceable and versatile tool wherever the trend rather than the precise answer is of importance. Over the past fifteen years, however, the growing need for accuracy and the increased emphasis on solution rather than formulation has introduced demands which the slide-rule cannot meet, from the points of view either of accuracy or of time-on-the-job.

The thoughts of management first turned to desk-top calculating machinery, which could without doubt meet the demand in accuracy and also show a considerable improvement in speed over the slide-rule. The digital desk machine was, however, a new concept in computing equipment and the aircraft designer sometimes scorned the accuracy to which computation was carried out—having regard to the fact, well known to him, that the input information might be 10 per cent or more in error.

The question of accuracy in face of this realistic comment bears some further discussion, and we can divide the field of computation into (a) those problems in which accuracy must be maintained, due to the accuracy of the input information and (b) those in which accuracy is required, due to the method of solution employed. Very many of our aircraft problems fall into the latter category and we must not place a premium on accuracy if it is only intermediate, but rather cast reflection on the methods which demand its introduction.

Let us now study the problem of computation and consider the significant factor in the employment of automatic aids. First of all there is the miscellaneous casual calculations, about which very little will be said and which are best solved by either the slide-rule or the desk calculator. Many, however, are casual on account of the assumptions made; and simplifying assumptions become less satisfactory as systems and configurations change, and are the product of experience rather than basic thought. It is inevitable, therefore, that progress will force us away from approximations and the charted regions of prior experience and back to fundamental dynamic relationships which are in general expressed as differential equations either ordinary or partial.

And where does analogue computation come into this? If some easily available system obeys the same equation of rules of nature as the system we are studying, then it may be more convenient to study the former rather than the latter. The application of this idea pervades the whole field of aircraft design. The project designer does not build to see if he can get all his fuel in a given project; he produces analogy in a line drawing and does his work on it. The designer does not leave aerodynamic forces to flight development but makes an original estimate of them in a wind tunnel. So, too, is the analyst coming around to building models of his problem—electronic models which behave as the final product should; and this idea introduces the era of the electronic analogue computor.

To put this relationship in its simplest form consider the systems shown in Fig. 1. At (a) is a dynamic system in which we have a vibrating mass M hung from a spring of constant H and connected rigidly to a damper unit of constant K. Then the equation of motion of this system is

$$M\frac{d^2x}{dt^2} + K\frac{dx}{dt} + Hx = F(t),$$

where $F(t)$ is the applied forcing function and x is the displacement.

At (b) we have an electrical system consisting of a resistance R, capacitance C and inductance L in series. Then the equation of the system is

$$L\frac{d^2q}{dt^2} + R\frac{dq}{dt} + \frac{1}{C}\,q = E(t)$$

where $E(t)$ is the applied voltage and q is the charge. If $L = M$, $R = K$, and $\frac{1}{C} = H$, then the variation of displacement with time in (a) and the variation of charge with time in (b) are identical. Thus we may predict the behaviour of the mechanical system by studying the behaviour of the electrical system. Another electrical system, shown at (C) has the same equation as system (a) if the variable resistors are set to equal $\frac{M}{K}$ and $\frac{M}{K}$ as shown. This system consists of three feedback D.C. amplifiers, and if R_1, R_2, and C are all set at unity it can easily be seen that the equation of system (c) is the same as system (a) and we have displacement in system (a) represented by voltage in system (c).

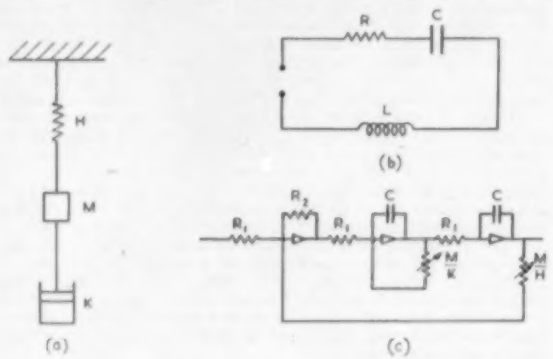


Fig. 1. Basic analogue-computor systems.

Thus we may very quickly predict the behaviour of a system which obeys ordinary differential equations by studying an electrical system which obeys the same equations; this is the underlying principle of the various analogue computors which are now available commercially.

Many different types of analogue computor are now on the market but in one form or another they all employ the computing principle outlined in Fig. 1(c). We shall confine our attention to the general-purpose instrument, a typical example of which has been developed by Short Bros. and Harland, Ltd., and is shown in Fig. 2. As far as is known it is at the moment the only British design in quantity production. In Fig. 3 is a comparable American design of roughly the same computational capacity.

It is two years now since a computor installation was established at Short Bros. and Harland, and originally one computor of the form shown in Fig. 2 was introduced. Estimates in those days foresaw a two- to three-hour daily utilization, which was considered well worth while. At the moment three such instruments are each working an eight-hour day and still the queue of jobs waiting for computor time gets longer. In this interval the application has extended into fields which two years ago were not considered suitable for analogue computation; the availability of these instruments has caused a radical change in design-thinking and a different approach in the project group to some features of aircraft design.

We have seen that the analogue computor is applicable to the solution of any problem which can be reduced to ordinary differential equations. Let us first of all consider the problem of aircraft stability and response; for many years the significant variables in a set of dynamic equations could be reduced to the sideslip derivatives in the lateral case and the static margin and damping in pitch contribution in the longitudinal case. With more advanced shapes, however, more variables (such as yawing due to roll and normal force due to change in speed) gained in importance; thus the concept of a stability diagram became of limited significance and was inevitably replaced by a response calculation. On paper this is a very tedious affair and out of the question in project design, which involves the optimizing of some aspect of the aircraft. The need in such work is for a versatile instrument of sufficient speed to enable the process of optimization to be carried out, and it is in this function that the analogue computor gains its greatest application. With such an instrument available, attention is focused on the ultimate response; and many of the techniques normally aimed at getting a reasonable picture of the situation with as little work as possible now become unnecessary.

The approaching era of automatic stabilization lends further

**The author is chief mathematician at Short Bros. and Harland, Ltd. He expresses thanks to the company's directors for their permission to contribute this article.*

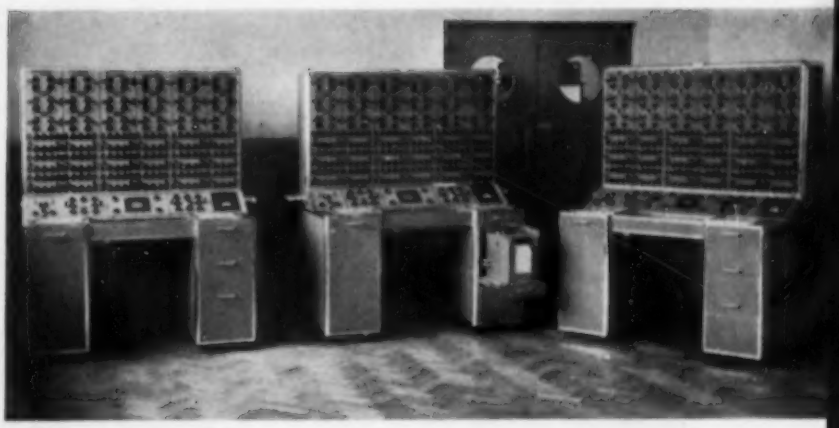


Fig. 2. General-purpose instrument developed by Short Bros. and Harland, Ltd.

weight to this argument, and in this field an analogue computor is an invaluable asset from the points of view of both analysis and synthesis. Here the problem of solution is much more significant than that of formulation, and we again have a case in which we attempt to optimize various contestants in a dynamic system the equations of which are known with a reasonable degree of accuracy. The accuracy of the instrument is, of course, much higher than that of this original information, and this is one of the problems which, if solved on paper, would involve the introduction of extra accuracy due to the method of computation involved.

Whilst on the subject of aircraft stability it may be useful to point out that not only can the analogue computor be used to estimate response from given data but that, if a flight test result is obtained, it may also be used to get an idea of the probable combination of aircraft derivatives which resulted in this response. Very often, too, some of the derivatives are known fairly accurately from particular tests; thus the computor may, by a process of trial and error, be used to estimate the more obscure derivatives.

An analogue computor with very little extra equipment may be used as a satisfactory handling simulator over short periods of time and an example of a mock-up installation is shown in Fig. 4. It consists of a cockpit provided with a spring-centred stick and rudder pedals to which are attached potentiometers which feed voltage into the computor proportionally to stick movement. The aircraft response is represented on instruments similar in appearance to those on a blind-flying panel but operated by the output voltages from the appropriate computor amplifiers. In spite of the obvious simplicity of the unit shown it has met with considerable success and when developed is expected to become a very significant tool in pilot-familiarization and design analysis.

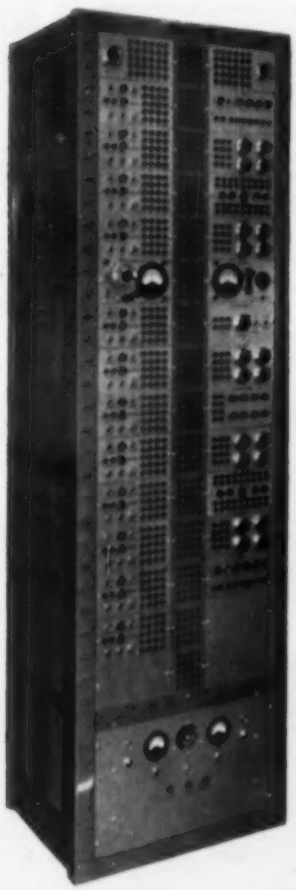


Fig. 3. American equipment of approximately same capacity.

In order to use such an instrument the computor must be capable of running on true time scale so that as parts of (say) a control system become available the actual pieces may be tested under operating conditions, the computor being used to simulate the remainder of the system. The logical extension of this idea sees the system represented completely by equations in the design stage, gradual replacement of the equations by actual components, and the final system required emerging when all the simulated parts have been replaced.

The usefulness of a general-purpose analogue computor is not confined to the aerodynamicist and project engineer but may just as satisfactorily be used in the field of aeroelasticity and in control-system engineering. In aeroelastic calculation one of the main applications is in the estimation of flutter characteristics, and this is in general a problem which can be reduced to the solution of a small number of second-order differential equations. Here again the analogue computor has given us a means of obtaining the structural response and has made the velocity of neutral equilibrium, the flutter speed, of less significance. Considerably more information may thus be obtained than by traditional flutter-calculation, and a greater degree of comparison obtained with flutter flight-test results without the danger of approaching close to the critical speed. Thus it is suggested that we should now be prepared to clear the aircraft by showing the structure response around the flight envelope and imposing a damping criterion on this rather than by quoting a flutter speed and not considering how slow or fast the degree of damping changes in the vicinity of this speed.

Many problems broadly covered by the term "dynamic stressing" can be reduced to the solution of a small number of ordinary differential equations and are thus suitable for solution on an analogue computor. Once the mode of deflection has been determined it can be used as a degree of freedom and its effect on the behaviour of the aircraft investigated. To quote an example, the problem of wheel shimmy has of recent months been formulated in such a way as to make a computor almost essential in its study. It has been shown that very unrepresentative results can be obtained by omitting certain freedoms, and the inclusion of all significant freedoms is much too large a job for desk computation.

With the introduction of power control and auto-stabilization into current high-speed aircraft the control engineer is faced with an analysis problem of considerable magnitude. A large volume of literature has, of course, been built up on the analysis and synthesis of such system and it is possible to get a fair idea of the behaviour of the system without actually solving the equations of motion. However, with the availability of an analogue computor, a change in outlook is brought about, based on the possibility of almost immediate analysis and synthesis of proposed systems. This cannot but lead to more complete analysis and improved design, with the subsequent reduction of testing and modification time. Servo-engineering theory is, however, still of considerable use; it frequently serves as a framework which assists in assimilating at a glance the result of very many computor traces, thus avoiding the tedious necessity of thumbing through sheaves of responses before a trend is recognizable. This leads us to suggest that the design manipulation should actually be done on the computor and only a recording of the response of the accepted system taken.

To date we have discussed linear problems, on which the analogue computor represents a considerable improvement both in time and technique. Many problems are, however, linear only by reason of restriction to small angle or other limiting assumptions, and with increasing refinement of design the practical significance of the problem may be lost in such approximations. We might well differentiate between problems in which non-linearizing assumptions are a refinement and those in which the non-linearity is of fundamental significance in the description of the problem. Both types of problems crop up in aircraft design, an example of the first being longitudinal stability with non-linear pitching moment characteristics and of the second the dynamics of a nosewheel aircraft at take-off. Various other parallel problems come to mind, such as the occurrence of full control-deflection in a flutter problem and the saturation of a unit in an automatic control system. All these problems are well suited to solution by analogue computation; and, given sufficient computing units, a problem can be increased in scope and further freedoms introduced in a way which the analyst could not hope to emulate and which he would not even consider. Here, then, we have an indisputable argument for the introduction of analogue computing equipment—the fact that if it were not available various manœuvres would have to be carried out in flight-test work without the prior assurance of calculated behaviour. A typical case springs to mind of testing at the stall when the

ANALOGUE COMPUTATION . . .

subsequent aircraft behaviour is very dubious; if sufficient analogue equipment were available a reliable estimate of behaviour could be found and the task of the test pilot very considerably eased.

In servo work, too, non-linearities are ever present. Linearizing assumptions can generally be made; but, particularly in the case of the hydraulic servo, they are of limited validity. This discussion again brings up the application of the analogue computor on true time to the simulation of a system in which an actual servo is operating, and thus by-passing another doubtful entity, the representation of a component by a mathematical equation. It might be added that the mathematical analysis of non-linear servos is still in its infancy and still confined to simple systems; so we see that in this context the analogue computor has neither an equal nor a rival.

We have to date confined ourselves to problems of which the electronic analogue computor is a direct analogy. It must not, however, be thought that its application is confined to this field and many and varied are the problems put to and solved by the installation at Short Bros. and Harland over the past two years. As an example a considerable amount of work has been put into examination of partial differential equations and their solution on a computor such as that shown in Fig. 2. A typical example of this is the problem of heat flow now becoming of considerable interest to the aeronautical engineer. This can be reduced to the solution of a set of partial differential equations in one freedom other than time, and these can easily be coped with on a computor installation of reasonable scope. Laplacian and Poisson equations may also be solved in two freedoms; but further exploitation in this direction, whilst possibly feasible, appears uneconomical in computor time and much more suited to solution on the automatic digital computors now becoming available. Another application has been to the solution of a set of simultaneous linear equations, where considerable variation was possible in some of the coefficients. Without suggesting that analogue computation should in general be applied to such problems, it may be remarked that in this particular case it was much more convenient than conventional digital methods.

As a matter of interest a list of problems carried out on the Short computor is given at the end of this article.

It is only by experience on computors of this type that a realistic picture can be obtained of the widening scale of their application and the changes they bring about in design-thinking. It is fairly well recognized that in a large proportion of cases the result merely shows that the system is not satisfactory; and the attraction of an analogue-type computor is that another attempt can then be made with the minimum of trouble, and the answer displayed in a fashion which facilitates quick comparison. Thus we see that an analogue computor is at the peak of perfection in its application if it is used not simply to analyse a system but rather to optimize it. In this capacity it has no peer and can be used to open up new vistas in the scope of design analysis, establishing for itself a place rivalling in popularity the simple elegance of the slide-rule of the previous generation.

Fig. 4. Use of analogue computor as a handling simulator.

SOME ANALOGUE COMPUTOR APPLICATIONS IN AIRCRAFT

(1) Aircraft dynamic stability and response investigations.
(2) Flutter calculations.
(3) Autopilot and auto-stabilizer synthesis and analysis.
(4) Helicopter stability and stabilization.
(5) Design of power-operated control systems.
(6) Analysis of spring tab systems.
(7) Design of servo systems—mechanical, hydraulic and electrical.
(8) Aircraft simulation over short periods of time.
(9) Undercarriage design and analysis.
(10) Transient stressing investigations on landing and in gusts.
(11) Equipment-mounting problems.
(12) Heat-flow investigations.
(13) Study of human-operator (specifically pilot) response characteristics.
(14) Flying-boat stability on the water.
(15) Flying-boat impact problems.
(16) Solution of linear simultaneous equations.
(17) Analysis of engine control systems.

TURBINE-TRANSPORT DISCUSSIONS

SEATTLE has been chosen as the meeting place for the international discussions to be held from August 8th-10th inclusive by the Institute of the Aeronautical Sciences on the subject of turbine-powered transport aircraft. The chief executive of B.E.A., Mr. Peter Masefield, will be guest of honour and principal speaker at a dinner on August 9th at the Olympic Hotel, venue for the conference; he is expected to discuss his company's experience of the Viscount.

It is reported that the meeting will attract some 600 representatives of airlines, aircraft engine manufacturers,, the U.S.A.F. and Government aviation agencies. The conference, the I.A.S. states, will have a strong international flavour; five of the 14 papers on the agenda (summarized below) will be delivered by non-American speakers. Delegates will be given an opportunity to tour the Boeing flight-test centre and factory in Seattle and to inspect various types of turbine-powered aircraft.

Monday, August 8th: chairmen, R. Dixon Speas, William Littlewood.—Small Turbine Thrust Augmentation for Transports, by Winfield H. Arata, Jr. (Fairchild). United States Airworthiness Performance and Operation Rules as Applied to the Viscount, by Derek J. Lambert (Vickers-Armstrongs). Large Turbojet Water-based Aircraft in the Transport Role, by Chauncey F. Bell (Martin). Considerations on Design and Development of S.E.210 Caravelle, by Jacques Le-Carme and Jean P. Gelos (S.N.C.A.S.E.). Characteristic Qualities and Design Problems of the Fokker F-27 Twin-Propeller Turbine Transport, by H. C. van Meerten (Fokker). Effect of Civil Turbine-Powered Transport Aircraft on the Air Traffic Control System, by Charles W. Carmody (C.A.A.)

Tuesday, August 9th: chairmen, R. W. Rummell, Lt. Gen. Joseph Smith, U.S.A.F.—Operational Experiences with Turbo-prop-Powered Transport Aircraft, by J. T. Dyment (T.C.A.) Ground Handling of Jet Transports, by Raymond D. Kelly (United Air Lines). Weather on the North Atlantic and Jet Airliner Operation, by E. B. Burton and C. L. Chandler (P.A.W.A.) The Role of the Turbine-Powered Seaplane in the Air Logistic Arm of the Navy, by James S. Russell (Bureau of Aeronautics, Department of the Navy). Economics of the DC-8, by Ivar L. Shogran (Douglas). Technical Development and Commercial Requirement, by C. H. Jackson (B.O.A.C.)

Wednesday, August 10th; Chairman, Charles Froesch.—10,000 Hours a Day, by R. E. Small and J. D. Wethe (G.E.C.). Boeing 707 Program, Progress Report, by George C. Martin (Boeing).

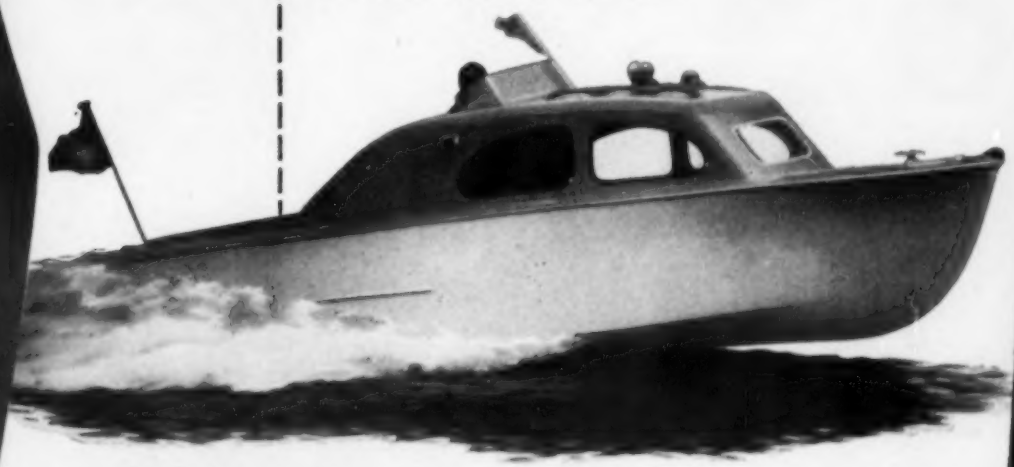
MORE ITALIAN CONTRACTS

TWO new military orders have been placed in Italy: one a wholly offshore-procurement order and the other a NATO-sponsored purchase. The offshore contract is for assembly of Fiat F-86K Sabres—a gun-armed variant of the F-86D all-weather intercepter which is already flying in Italy; the new contract amounts to $7.35m (£2,600,000).

A further $1.3m (£450,000), three-quarters of which has been paid by the U.S.A., has been allocated to production of three prototypes of the Article ("battering ram") light jet interceptor at the Aerfer factory at Naples. Total Italian offshore contracts now amount to $500m (£178,000,000).

Moulding the future . . .

This 20 ft., 22 m.p.h. 2-berth *Tuna Twin* motor cruiser built of F.R.P. by W. J. Tod Ltd. of Weymouth. Why F.R.P.? Let Tod's testify ; " *Fibreglass has . . . a higher strength weight ratio than wood, steel or aluminium alloy, coupled with exceptional flexural strength, which prevents cracking, denting or splintering, it is immune to climatic extremes and marine attack, does not absorb water; is rot proof and non-corrosive and has the colours pigmented into the laminate to dispense once and for all with the worry and expense of annual scraping and repainting.*"



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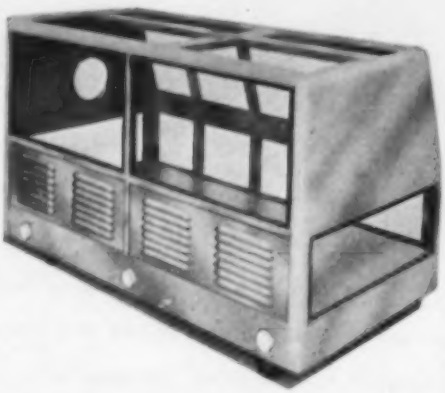

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CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

High-speed Tunnels

IN reply to "Prober" (June 24th), your correspondent appears to be under two misapprehensions. Firstly, the cost of the Armstrong Whitworth supersonic wind tunnel was borne entirely by the firm and amounted to some £200,000.

Turning now to the remark "top and bottom of the working section were machined from iron castings", this is, of course, quite true, as this tunnel is of the variable-density type and must be completely free from leaks at all points. However, it does employ a ventilated throat, and this was exhibited in a partly completed form at the opening ceremony. The plenum chamber behind the ventilated portion of the working section forms a dead air space bounded on the outer side by these impervious iron castings.

Your correspondent can, therefore, rest assured that we are taking heed of this latest American advance in tunnel design and I would remark that this idea was first brought to my attention in America in 1947, since when I have considered it to be an essential feature of every transonic tunnel.

Baginton, Coventry. W. F. HILTON.
Chief Aerodynamicist, Sir W. G. Armstrong Whitworth Aircraft, Ltd.

They Also Served . . .

I WAS very interested to read the letter from H. V. Cossons (*Flight*, July 15th) on the defence of airfields in the south-east of England during the Battle of Britain, for my battery, the 138th Light Anti-Aircraft Battery, Royal Artillery, had a troop defending Lympne airfield during the Dunkirk evacuation. I well remember a squadron from the French Air Force operated from there at the time. They were equipped with Marcel Bloch fighters armed with two 20 mm Hispano cannon mounted in the wings and two machine guns in the body. They were led on patrol by a twin-engined Potez fighter with twin rudders, looking like a smaller and radial-engined version of the Messerschmitt 110. A huge Armstrong Whitworth Ensign airliner had crash-landed on the airfield and so had a Westland Lysander; in an adjacent field an Avro Anson was pitched up on its nose. I remember seeing Hawker Hector biplanes with Napier Dagger engines take off with supplies for the troops besieged in Calais.

It may be news to some people that this last of a long line of Hawker biplanes saw service in the Battle of Britain, or at least just before it.

The 138th Battery was divided into three troops and, during the whole of the Battle of Britain one troop defended Manston Aerodrome; another defended the radar compound between St. Margaret's Bay and Dover; and the troop in which I served as a gunner defended Dover Harbour itself.

It seems incredible to realize that we never, to the best of my knowledge, had a man killed or a gun knocked out during the whole of that time. I don't think that there is another Battery in the Royal Artillery which has helped to defend three such important objectives against such odds, without loss, at one and the same time.

Sidcup, Kent. A. G. WILSON.

Soviet Flapping Wings—and Other Things

THE letter by Mr. Galitzine (July 15th) regarding his great-uncle's ornithopter glider is of considerable interest. Perhaps the facts which you suggest, that the Kashuk does not operate on the same principle enables the Soviets to claim another first.

As far as I can recall, the Golovkine ornithopter has until now been unknown outside Russia. There is an article on Russian ornithopters, mainly gliders with only manual power, in *Letectvi*, 26, 245-250 (1950) but this Czech journal does not mention Golovkine. Designs from the 19th century to the 1930s are described, but two very interesting designs by B. I. Cheranovskii are omitted. They are described in *Samolet*, No. 12 of 1937 on pages 36-37. His first ornithopter was built in Morkva in 1921, and was a biplane type with pedal-driven mechanism. This was *not* designated BICh-1, by the way. The BICh-16 of 1934 rather looks as if it were operated by hand, but *Samolet* says that tests were not completed.

No details are known of a bat-winged ornithopter of about 1933 mentioned in Röda Virigar (Malmö, 1946).

I would like to make a comment on the Mig-15 cutaway on p. 112 of *Flight*, January 28th. I am not sure whether all Mig-15s carry a camera in the position shown, or not, but the omission of guns in the original Russian drawing may have been a "security" measure. Such practice is common enough now, but very tantalizing. The Russians have apparently a sort of graded part-publication system. I think the first trace of a Mig-15 that I saw in a certain Soviet periodical was half a nose-wheel and half a mainwheel in the background of a picture showing officers working out combat manœuvres with Yak-15 models! A bit later came a photograph in which the air-brakes have been painted out. The Il-28 is beginning to make an appearance now; a photograph of the nose portion, conveniently covered by tarpaulins, has been graciously released by the Soviet censor!

To go back a little further in time, the photograph on page 6 of your July 1st issue is very fascinating as it shows a couple of Shavror Sh-2 amphibians. This appeared in 1932 and was developed from the similar Sh-1 of 1928! It would be interesting if we could learn after a few years whether the Sh-2 or the Po-2 of 1927 will have gained the prize for long service. The An-2 seems to be replacing the Po-2 on a large scale now.

Finally, I would like to go back again to the First World War. A young Russian aviation engineer called Osipenko was working in London in the years 1915-1916 and built a large biplane at Hendon. A photograph appears in *The War Illustrated* (Ed. Hammerton) 2, 591, 1915. There is another photograph in another issue but I cannot find it at present. Has any reader a knowledge of Osipenko's work here or in Russia? Kennedy later came back to England but I do not know whether to file Osipenko's Hendon machine with the Russian aeroplanes.

Okehampton, Devon. DENYS J. VOADEN.

[C. J. H. Mackenzie Kennedy was a leading engineer in Russia, but on the outbreak of the 1914-18 War returned to this country and experimented in the construction of large bombers.—Ed.]

The Not-so-good Old Days

I ARRIVED at Uxbridge in June 1925, long after your correspondent Edward Hoctor (Correspondence, June 10th). Even at that time the senior N.C.O.s were more harassed than the recruits, four hundred of whom were picked for the P.T. and Torchlight Display at the Wembley Exhibition. In record time we were 100 per cent perfect, thanks to the chief drill instructor, F/L. "Stiffy" Wombwell.

The food was poor and little of it—one small round loaf between six men! The real tyrants were the cook-house staff, who demanded cigarettes or money for second helpings. We recruits were highly delighted when some of these sharks were court-martialled.

Darlington, Co. Durham. Ex-R.A.F. 370045.

Victoria Falls Airways

WITH great interest I followed the article "Game-Watching from the Air," by my friend T. Ivan Pyle, published in *Flight* of July 1st. I happened to visit Victoria Falls Airways a few days after Mr. Pyle and I flew in one of her attractive Tri-Pacers (VP-YKS) over the Victoria Falls which, I agree with Mr. Pyle, make a breath-taking spectacle.

Victoria Falls Airways have two (not four) Tri-Pacers, which have respectively flown 800 and 1,000 hours so far. I too had a short interview with Mr. Colman Myers, and he told me that Victoria Falls Airways had just ordered two Piper Apaches. Some time ago, the Piper Apache *Spirit of Pretoria* flew with the Piper brothers in 95 hours from Lockhaven to Pretoria in South Africa. This *Spirit of Pretoria*, now owned by a sugar planter in Zululand, flew to Pretoria *via* Livingstone, where Mr. Colman Myers was able to fly it from his own airstrip. He was so enthusiastic that he ordered two Apaches at once. They will next year replace the Rapides on the game-flights. The 880-yard strip used by Victoria Falls Airways is also used by the Livingstone Aero Club, flying, among other aircraft, a Fairchild and a Piper Cruiser.

Boskoop, Holland. HUGO HOOFTMAN.

FORTHCOMING EVENTS

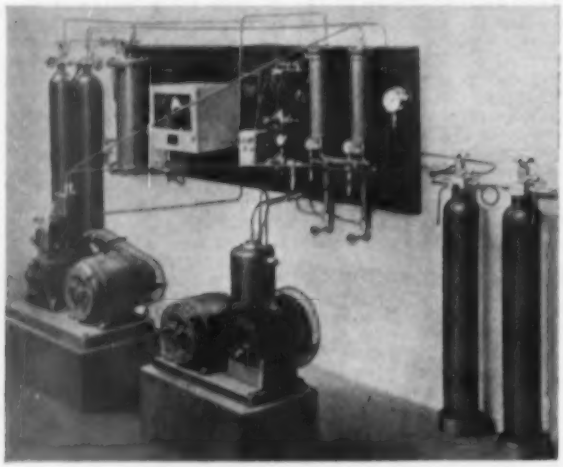
July 23-Aug. 1. National Gliding Championships, Lasham, Hants.
Aug. 6-7. Dieppe Air Rally.
Aug. 13-18. Fourth Air Tour of Switzerland.
Aug. 15-26. Commonwealth Survey Officers' Conference, Cambridge.
Aug. 19-20. R.Ae.C.: Fourth National Air Races Meeting and Lockheed Aerobatic Trophy Competition, Coventry.
Aug. 21. Northamptonshire Aero Club: At Home.
Aug. 27. R.N.A.S. Anthorn, Cumberland: Air Day.
Sept. 3. Leicestershire Aero Club: Air Display.
Sept. 3-5. U.S. National Aircraft Show, Philadelphia.
Sept. 5-11. S.B.A.C. Show, Farnborough (Public Days, 9th, 10th and 11th).
Sept. 12-18. Battle of Britain Week.
Dec. 16. London Airport inauguration by H.M. the Queen.

THE INDUSTRY

Three-stage Air Compressor

FOR installation in one of their plants at Haren, near Brussels, a three-stage air compressor has been supplied to Société Anonyme Belge de Constructions Aéronautiques (S.A.B.C.A.), who are building Hunters for NATO. The air compressor, produced by Williams and James (Engineers), Ltd., of Gloucester, has been installed in connection with the testing of undercarriages and other hydraulic equipment.

The output of the plant is six cubic feet per minute of free air at up to 3,500 lb/sq in pressure. Two water-cooled compressors are driven through vee belts by motors of 5 b.h.p. and 2½ b.h.p. respectively, the second unit being a booster providing a third stage of compression. The control panel includes coolers, air dryer, electrical contractors and pressure switch. The coolers are equipped with moisture traps to allow condensation to be drained away.



The air compressor installed by S.A.B.C.A.

The plant is fully automatic up to 1,000 lb/sq in, producing a constant supply of air. After the second-stage compression, air is passed through the Birlec Lectrodryer, whence it is delivered in a very dry state.

When air at 3,500 lb/sq in is required, the booster unit is switched on and air is drawn through a pressure-reducing valve (which limits intake pressure to 600 lb/sq in), to the suction side of the booster. After compression, air is fed to the receivers on the right-hand side of the panel.

Smiths Technical Services Appointment

IN succession to Mr. L. R. Langmead, who died recently, Mr. Eric Roy Sisson, A.R.Ae.S., has been appointed technical services manager to Smiths Aircraft Instruments, Ltd. Latterly with B.O.A.C., as project engineer on Comet aircraft, Mr. Sisson has spent his life in aviation. After a four-year apprenticeship at the Hawker Aircraft, Ltd., starting in 1930, he joined the de Havilland drawing office at Stag Lane and then went to that company's service department. In 1937 he joined Imperial Airways and was for several years stationed in Africa, as a flight engineer and station engineer. During the war he flew as a B.O.A.C. engineer officer in the Boeing 314 transatlantic flying-boats. In 1946 B.O.A.C. sent him to Lockheed Burbank plant as one of the Corporation's representatives responsible for accepting the first of the Constellations which they ordered. Mr. Sisson, who is 40 years of age, lives at Welwyn Garden City, Herts.

Mr. E. R. Sisson.

This new type of lightweight starting and servicing unit, employed by B.E.A. for its Viscounts, is equipped with an air-cooled diesel engine driving a D.C. generator. A Varley battery enables a heavy starting current to be supplied, by virtue of low internal resistance. The manufacturers of the unit are Red Devon, Ltd., of Totnes.

Jet-pipe Temperature Checking

A WELL known American item of test equipment, the B. and H. Jetcal gas-turbine temperature-system tester, is to be manufactured under licence in this country.

Obviating the necessity for running engines in order to check the accuracy of jet-pipe thermocouples, the Jetcal is a heater embodying a standard thermocouple; and the associated apparatus incorporates a potentiometer which enables the aircraft instrument reading to be compared with the output from the standard thermocouple. The tester is simply plugged into the hangar power mains, and the whole check, it is stated, need not take more than 15 minutes. The saving of cost in comparison with an engine-run is, clearly, very large indeed.

The British firm concerned are Bryans Aeroquipment, Ltd., of Willow Lane, Mitcham, Surrey, who have secured sole rights for the manufacture and sale of Jetcal "G" and "H" models for the whole of the British Commonwealth, Europe, and the Middle and Far East, with the exception of Canada and Japan, and of Soviet-controlled countries.

IN BRIEF

For the year ended March 31st, 1955, Blackburn and General Aircraft, Ltd., announce a group profit of £520,857 before providing for taxation (1954, £451,607). The 1955 figure includes £20,110 provision in previous years and no longer required.

* * *

Manufacturers of air compressors and diesel engines, the Stockholm firm of Calmodiesel AB have appointed Muir and Adie, Ltd., of Croydon Airport, to be their agents in this country.

The Bristol Aeroplane Co. of Canada has announced the appointment of Mr. V. V. R. Symonds as sales manager (aircraft) in their aircraft division at MacDonald Brothers Aircraft, Ltd., Winnipeg. He will be principally concerned with the sale of the Britannia and the Bristol range of helicopters, both in Canada and the U.S.A.

Mobile industrial X-ray equipment, in 150, 220, 300 and 400 KVp versions, is described and illustrated in a leaflet issued by Pantak, Ltd., 72-76 Alpha Street, Slough, Bucks.

* * *

Wheel- and bearing-pullers of exceptional power, some of them with hydraulic operation, are listed by E. F. Allchin and Co., 137 High Street, Aston, Birmingham 6.

* * *

BX Plastics, Ltd., Higham Station Avenue, London, E.4, have published an informative data folder dealing with the applications and characteristics of their thermoplastic raw materials. It is their claim that their range of these materials is the widest in the country.

* * *

A number of Netherlands aviation executives attended a recent demonstration of the Stream-Line filter for aviation fuel. Held at the new Fokker factory near Schiphol Airport, the demonstration was arranged by J. C. Bernelot Moens of Amsterdam, who represent Stream-Line Filters, Ltd., in Holland.

Two of many outstanding contributions to Britain's Air Power

The Gloster Javelin
by
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Armstrong Siddeley Sapphire Jet engine
by
Bristol Aero Engines Co., Ltd

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CIVIL AVIATION

VISCOUNT NEWS

AN order for five Vickers Viscount 700D aircraft from Indian Airlines Corporation, deliveries to begin in the summer of 1957, was announced by Vickers-Armstrongs (Aircraft), Ltd., last Friday. This brings the total number of Viscount sales to 234.

The first Viscount service inside the U.S.A. was due to begin on Tuesday last, July 26th, on Capital Airlines' Washington-Chicago route. Scheduled westbound and eastbound times are 2 hr 20 min and 2 hr 10 min respectively. Capital's first Viscount, delivered last month, has now completed the first part of an extensive programme of training and demonstration flights, visiting New York, Rochester, Buffalo, Chicago and other cities.

Pioneer Viscount operators in North America, T.C.A. are to introduce a second service into New York from Montreal, at a frequency of three each way per day; flying time will be 1 hr 35 min. T.C.A.'s Toronto-to-New York service has been flown at a five-per-day frequency each way since early April—with a resulting passenger increase of 32.6 per cent on this route.

AGREEMENT WITH GERMANY

AN agreement on air services between the United Kingdom and the Federal Republic of Germany was signed in London on July 22nd by Lord Reading, Minister of State for Foreign Affairs, Herr Hans von Herwarth, the Ambassador of the Federal Republic of Germany, and Dr. Kurt Knipfer, Ministerial Director (Civil Aviation) of the Federal Ministry of Transport. Under the agreement the United Kingdom grants rights to airlines of the Federal Republic: to fly to London, Manchester, Glasgow and Edinburgh; to call at Manchester on routes to Dublin and to North America; at the Bahamas on a route to the South American republics; at Singapore on a route to Australia; and at Kano or Lagos on a route to South Africa.

In return, the Federal Republic has granted rights to U.K. airlines to fly to Hamburg, Hanover, Düsseldorf, Cologne, Frankfurt, Munich, Stuttgart and Nuremberg and beyond, if desired; to Scandinavia, Prague, Jugoslavia, Austria, Athens, Istanbul, Cyprus and Cairo; also through Frankfurt, Düsseldorf and Munich to the Middle East, Malaya, Indonesia, Hong Kong, the Philippines, Australasia, China and Japan; and to West Africa and South Africa. The agreement is subject to ratification.

B.E.A. PROGRESS

IN the July issue of the *B.E.A. Magazine*, Mr. Peter Masefield reports a steadily improving B.E.A. economy, and gives the current revenue-earning rate as some £2m per month. May and June, he states, produced even bigger profits than the £52,000 earned in April. The continued steady growth of traffic was reflected in the 22 per cent increase in business in the first six months of 1955, compared with the corresponding period last year; statistics of passengers carried over the same periods showed an increase of 135,000 this year.

The Corporation's drive for freight, Mr. Masefield writes, has been "somewhat handicapped by inadequate freight space at London Airport—and by archaic methods still insisted on by the Customs and Excise who, among other things, clear only urgent priority freight at night and at week-ends." B.E.A.'s freight target for the year was £3m of revenue.

STRATOCRUISER ACCIDENT REPORT

ACCORDING to the official report* of the public inquiry into the accident to B.O.A.C. Stratocruiser G-ALSA on Christmas Day, 1954, at Prestwick Airport, the cause of the accident was "errors of judgment on the part of the Captain." In a reply to one of the questions put by the Lord Advocate, the court stated that the captain (a) started his final approach to land at too steep an angle and (b) flared out too late and too severely, with the result that the aircraft sank and hit the ground short of the runway.

"During the flare-out," the report continues, "the aircraft passed through low cloud, thus reducing the captain's visibility. The accident was also contributed to by the failure of the First Officer to carry out the order of the captain to put on the landing lights, which prevented the captain from observing timeously the low cloud over the approach lights."

Commissioner of the inquiry was Mr. C. W. Graham Guest, Q.C., who was assisted by two assessors, Capt. E. D. Avary (of Pan American Airways) and Capt. I. C. Grant. The court met at Ayr from March 28th to April 6th; made visits to Prestwick, where they inspected the wreckage of G-ALSA and viewed another B.O.A.C. Stratocruiser; observed the G.C.A. system and the control tower in operation; and visited London Airport, where they were shown a Stratocruiser simulator.

**To be available in printed form from H.M.S.O. in a few weeks' time.*

At the time of the accident, G-ALSA was approaching to land on runway 31 at Prestwick after a flight from London Airport. It carried a crew of eleven, four of whom were killed, and 25 passengers, of whom 24 were killed. Captain W. L. Stewart was in command, and his first officer was K. A. King. The report of the inquiry states that the flight from London to Prestwick was uneventful up to the time of the final approach to the runway. A recording of the G.C.A. talk-down had shown that Sugar Able was above the glide-path during much of the talk-down; the evidence of the captain and the first officer, however, disagreed concerning what happened during the final stages of the approach. Capt. Stewart reported that, after completion of the talk-down the aircraft broke into V.F.R. conditions approximately a quarter of a mile short of the approach lights, or three-quarters of a mile from the runway threshold. The aircraft's height at this point was estimated to be 700ft. Eye-witness accounts had shown that, a few seconds later, the aircraft struck 127ft short of the threshold.

Examination of the wreckage had shown that the flaps were set at 35 deg, and Capt. Stewart had submitted that a sudden retraction from the 45 deg position had caused the aircraft to sink and so hit the ground. A Boeing test report, however, had shown that there was little difference in stalling speed between the two settings; and as the aircraft did not approach these speeds prior to the accident, the Commissioner concludes that the retraction of the flaps to 35 deg did not contribute to the accident. "Flap retraction may have played a minimal part in the final sink," his report continues, "but in our opinion, owing to the captain's errors of judgment, the aircraft would in any event have hit the ground at about the same point."

Among the court's conclusions and recommendations are:—

Capt. Stewart's orders to put on the landing lights were not carried out by 1st/Off. King. The landing lights would have enabled the captain to observe earlier the presence of low cloud into which the aircraft passed immediately prior to striking the ground.

Weather conditions were such that the captain's decision to land was correct. The weather minima of B.O.A.C. on runway 31 at Prestwick are adequate to ensure the safe operation of aircraft.

The light at Prestwick was adequate, although this will be considerably improved when the Calvert cross-bar system is installed.

S.A.S. ORDER MORE DC-7Cs

A FURTHER six Douglas DC-7Cs have been ordered by Scandinavian Airlines System, at an estimated cost of 200m crowns (approximately £13,800,000). Eight machines of this type had already been ordered by S.A.S.

NEW FOREST ACCIDENT

A DOVE of Cambrian Air Services, Ltd., crashed in the New Forest, near Fritham, Hants, on July 23rd. The pilot, Capt. Robert Carson, was killed and six passengers were injured (two not seriously). The Dove, having left Rhoose Airport, Cardiff, was flying to Paris and was to call at Southampton.

K.L.M. AND CEYLON

NEGOTIATIONS have been opened between K.L.M. and the Ceylon Government for the formation of a corporation "in the field of international aviation." The first talks have been held between Hr. J. Boender, the K.L.M. representative in Ceylon, and Major Jayewickrima, the Transport Minister. The airline's vice-president, Hr. B. van Delden, is due in Ceylon shortly for talks with the Government before concrete proposals are put forward.

THE SOUTH BANK SERVICE

THE inaugural flight of the scheduled B.E.A. helicopter service between the South Bank site and London Airport was made last Monday, with Mr. J. Boyd-Carpenter, Minister of Transport and Civil Aviation, Mr. Profumo, Joint Parliamentary Secretary to the M.T.C.A., Lord Douglas of Kirtleside and Mr. Peter Masefield, respectively chairman and chief executive of B.E.A., as passengers. Mr. Masefield said that the service would provide experience with a view to city-centre flights between London and Paris, Brussels, Amsterdam, Manchester and Birmingham. Mr. Norman G. M. Pritchard, chairman of the L.C.C., Mr. I. J. Hayward, leader of the L.C.C., and Sir George Cribbett, Deputy Secretary of the M.T.C.A., were taken for a flight.

There are eight return services every day except Saturdays and Sundays. Single fare is 35s, and the journey of some 17½ miles takes 15 min. From South Bank the route follows the course of the river as far as Putney Bridge, and thereafter lies over Twickenham and Hanworth. The return flight is by way of Harmondsworth, Boston Manor and Kew Gardens to Putney

CIVIL AVIATION . . .

Bridge, thence once again along the river. Two Westland S-55s, with floats and silencers, are employed. They carry a maximum of five passengers into London and four outward bound. In due course the present float undercarriage will be replaced by inflatable flotation bags, which should permit two additional passengers to be taken and will allow a useful increase in speed.

On the basis of 100 per cent load factor a loss of £322 a day will be incurred by the running of the new service—a loss which will be borne by the tax-payer as the price of development.

On the outward run the helicopters pass close by the House of Lords, and on July 20th—the day on which a *Flight* representative made a trip—a speech by Lord Munster is said to have been rendered almost inaudible. Lord Lucas of Chilworth asked whether something could not be done about "this infernal noise." The Earl of Munster said he agreed that the noise did cause a difficulty, and he would see that a complaint was made to the Leader of the House.

On the following day Mr. Peter Masefield, B.E.A.'s chief executive, said: "We intend to use a technique designed to avoid disturbance. On take-off from the South Bank the helicopters will climb as rapidly as possible and will fly on the south side of the river while passing Parliament. The approach before landing will also be made from the south side. The machines will keep at least at 1,000ft until they are near the landing site. All B.E.A. helicopters using the South Bank are fitted with a specially developed silencer. Other machines from the R.A.F., the Navy and the Royal Canadian Air Force using the site have no silencers."

The Associate Editor of *Flight* describes a double journey as follows:—

On the gusty morning of July 20th I reported to the South Bank and found a B.P. tanker and a fire engine huddled together with a chequered control van. The windsock was straining directly towards the County Hall as R.M.A. *Sir Kay* came woofling round the corner and squatted down on the grass. The pedigree of this float-equipped and silenced conveyance (*vide* the A.R.B.'s *Register of British Civil Aircraft*) is G-ANUK, Westland S-55 Series I, WA 39, P. & W. Wasp R-1340-40 engine, maximum all-up weight 7,500 lb; and in its B.E.A. colours it is a becoming adjunct to the London scene.

The wind lying as it did, Capt. Dibb said he would take only two passengers this trip; so with myself in sole, rajah-like, occupation of the cabin, and a photographer on the flight deck, we took the air at 11.02 a.m. by the Shell-Mex clock. Swinging up and out over Hungerford Bridge, we passed Big Ben *tête-à-tête* and beheld the grandeur of London with a sense of rare privilege. The Battersea Pleasure Gardens, the power station pluming smoke across our river-hugging track, the Albert Hall distant, the Chelsea football ground close below . . . these were the real London, seen on a new wide screen.

I stretched my legs with unaccustomed freedom and appraised the cabin indulgently. The grey, red and cream furnishings seemed just right; so, too, did the large windows, the ashtrays and the little floor-mats. Even the noise and vibration (for both were indubitably present) could be happily endured with such comforts and sights around one.

By 11.14 we were edging across the Bath Road and dropping down towards L.A.P.'s Central Area. We could have touched down 13 minutes or so after leaving the South Bank—and, lately having braved out a succession of coach journeys to and from the Waterloo Terminal, I was much heartened by the thought.

We swept along the south-east face of the Central Area, with its population of Viscounts and Elizabethans, and headed back. Over Kew Gardens the sun threw the shadow of the rotor head on to the port float, and as the head revolved and the '55 wallowed gently, I was irresistibly reminded of a paddle-steamer.

As we slipped in round the corner of County Hall I glimpsed a gentleman in one of the top offices and smiled. He did not smile back.

WEATHER RADAR FOR T.W.A.

AFTER evaluation tests with R.C.A. weather surveillance radar equipment fitted to three of its 20 Super-G Constellations engaged on transcontinental passenger services, Trans World Airlines has decided to equip the remainder of these aircraft with this type of installation. The total cost is estimated to be some £135,000. The radar unit incorporates a 34-in diameter dish-shaped antenna, and is said to be capable of detecting thunderstorms at a range of 150 miles.

BREVITIES

DURING the first six months of 1955, T.W.A. carried a record total of 1,899,000 passengers, an increase of 16.5 per cent over the same period of 1954. The major increase was on U.S. domestic routes, where passenger traffic increased 17 per cent to 1,794,000.

* * *

Sabena have announced the appointment of Mr. D. A. le Roy du Vivier as the company's general manager for North America.

* * *

Mr. Hugh Dentry has succeeded Mr. Tim Drysdale as publicity manager of Trans-Australia Airlines. Mr. Dentry was previously sales manager for Kiwi Australia, Ltd.

* * *

At a recent meeting in New York, Mr. Warren Lee Pierson, chairman of T.W.A., was elected president of the International Chamber of Commerce. He had previously served as president of the United States council of the I.C.C., and succeeded Camille Gatt (Belgium) in his new post.

* * *

Recently inaugurated by Air-India International is a weekly first-class London-Bombay Super Constellation service known as "The Flying Rani." Outbound, on Sundays, stops are made at Dusseldorf, Rome and Cairo; while on the return flight (leaving Bombay on Saturdays) Cairo is the only stop *en route*.

* * *

The Australian Air Pilots' Association is negotiating with all Australian domestic airlines for salary increases of up to 20 per cent, and superannuation of up to £12,000 after 20 years' service. The Association has refused to accept the offers of A.N.A., T.A.A. and Ansett of a £75 annual increase for Grade 1 Captains and £40 for Grade 1 First Officers.

* * *

The resignation of Mr. Gerald Packer from the vice-chairmanship of the Australian National Airlines Commission, which operates Trans-Australia Airlines, has been announced. The Australian Minister for Civil Aviation, the Hon. Athol Townley, stated on this occasion that Mr. Packer had made a most valuable contribution to the successful results which T.A.A. had achieved, during his period of over five years as vice-chairman.

As reported last week, over 2½ million passengers were carried by the Corporations and their Associates during the financial year 1954-55. Detailed operating statistics are given in the two tables here reproduced, which refer respectively to the month of March and to the full financial year.

CORPORATIONS AND ASSOCIATES—TRAFFIC STATISTICS: MARCH 1955

	B.O.A.C.		B.E.A.		Associates	
	March 1955*	% change on March 1954	March 1955	% change on March 1954	March 1955	% change on March 1954
Aircraft miles flown ...	2,622,000	+8.3	1,535,000	+1.4	336,000	+26.8
Passengers carried... ...	27,304	−0.3	119,411	+18.6	8,675	+61.5
Freight carried (short tons)	638	+11.7	1,591	+23.6	1,221	+57.5
Mail carried (short tons) ...	321	+8.4	609	+2.7	3	+50.0
Capacity short ton-miles ...	18,147,000	+9.6	6,906,000	+20.5	979,000	+36.4
Load short ton-miles ...	11,583,000	+2.3	4,562,000	+22.5	648,000	+58.8
Overall load-factor(%) ...	63.8	68.4†	66.1	65.0†	66.2	56.8†
Available seat-miles ...	119,439,000	+7.0	57,244,000	+16.1	9,030,000	+39.6
Passenger-miles flown ...	72,249,000	−2.0	39,732,000	+25.9	5,822,000	+64.4
Passenger load-factor(%)...	60.5	66.0†	69.4	64.0†	64.5	54.7†

* February 2/5th-March 31st, 1955. † March 1954 actual load factors.

TRAFFIC STATISTICS: FINANCIAL YEAR APRIL 1954—MARCH 1955

	B.O.A.C.		B.E.A.		Associates	
	1954-55	% change on 1953-54	1954-55	% change on 1953-54	1954-55	% change on 1953-54
Aircraft miles flown ...	30,761,000	−4.5	23,034,000	−2.5	6,392,000	+35.6
Passengers carried... ...	281,207	−3.1	1,874,316	+13.1	345,003	+40.9
Freight carried (short tons)	6,513	+7.5	19,120	+13.0	49,581	+26.9
Mail carried (short tons) ...	3,468	+1.2	6,964	+5.8	50	+56.3
Capacity short ton-miles ...	209,182,000	−0.9	97,754,000	+17.6	17,604,000	+39.7
Load short ton-miles ...	133,305,000	−2.0	63,063,000	+18.7	10,624,000	+39.4
Overall load-factor (%) ...	63.7	64.5*	64.5	63.9*	60.3	60.5*
Available seat-miles ...	1,419,121,000	−1.1	843,297,000	+16.5	139,626,000	+47.0
Passenger-miles flown ...	874,262,000	−4.1	577,076,000	+20.2	85,577,000	+51.5
Passenger load-factor(%)...	61.6	63.5*	68.4	66.3*	61.3	59.5*

*1953/54 actual load factors.

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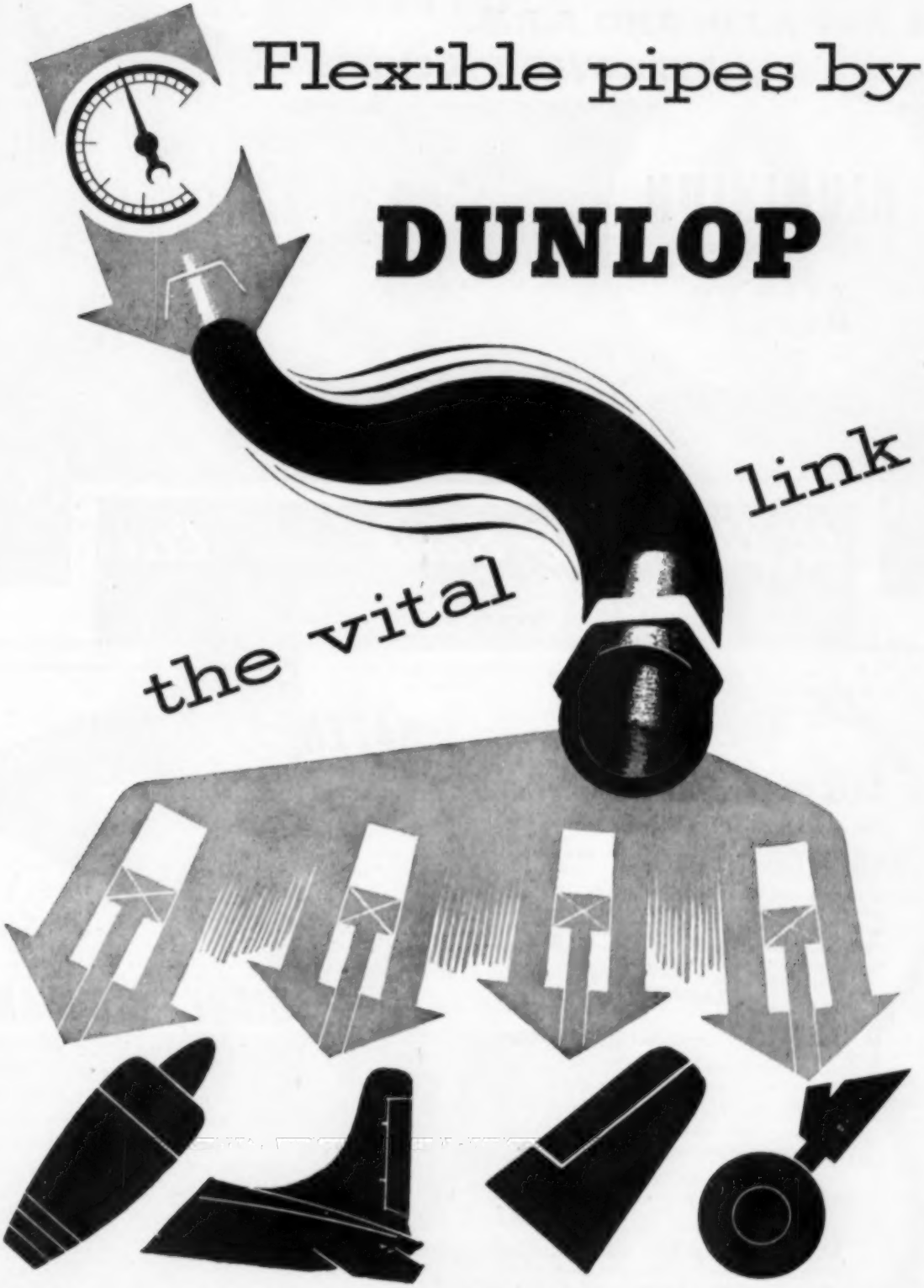

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SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

Australian Aide-de-Camp

THE Director of Training for the R.A.A.F., G/C. Gibson, has been appointed aide-de-camp to the Queen as from August 6th. He succeeds A. Cdre. Hannah, who has held the appointment for the past three years.

G/C. Gibson won his D.F.C. while serving with No. 10 Squadron, R.A.A.F., in England during the war.

R.A.F. at French Air Display

THE aerobatic team of four Hunters from No. 54 Squadron, and a formation team of four Canberra T.4 trainers from No. 231 O.C.U., are scheduled to represent the Royal Air Force at the French National Air Meeting, to be held at Metz on Sunday next, July 31st. A Hunter from Fighter Command Weapons School will perform individual aerobatics.

The Canberras will be led by W/C. A. J. Picknett, D.F.C., chief instructor at the O.C.U., and the other members of his team are S/L. J. F. C. Melrose, D.F.C., S/L. S. G. Hewitt, A.F.C., and F/L. R. I. Young.

S/L. P. J. Fry, D.F.C., is due to fly the individual Hunter, and the composition of the 54 Squadron team will be identical with that portrayed on page 155.

A.V-M. J. G. Kerr, who has been appointed R.C.A.F. Air Member for Personnel at Air Force H.Q., Ottawa.

Malta Defence Exercise

THE annual defence exercise on Malta, G.C., took place last week and saw most of the population of the island embroiled in defence activities of all kinds. Subjected to air attack from bombers, fighters and carrier-borne aircraft, as well as from light naval craft and frogmen, the defenders had to provide fighter defence, anti-aircraft gunnery, mine-watching, bomb-disposal and civil defence. Assisting with interceptions was a French squadron of Mistrals, while the attacking Lincolns and Canberras of Bomber Command were supported by Banshees, Skyraiders and Savages from ships of the U.S. 6th Fleet. Altogether over 700 sorties were flown by British, American, French and Italian aircraft taking part.

The carrier *Eagle* was base for squadrons of Sea Hawks and Wyverns which flew on the defending side, together with Shackletons of No. 37 Sqn., Meteor night fighters of No. 39 Sqn., Venoms of No. 73 Sqn., Meteor 7s of No. 728 Sqn., Fleet Air Arm, Neptunes of VP-11 Sqn., U.S. Navy, and Mistrals of No. 7 Sqn., French Air Force.

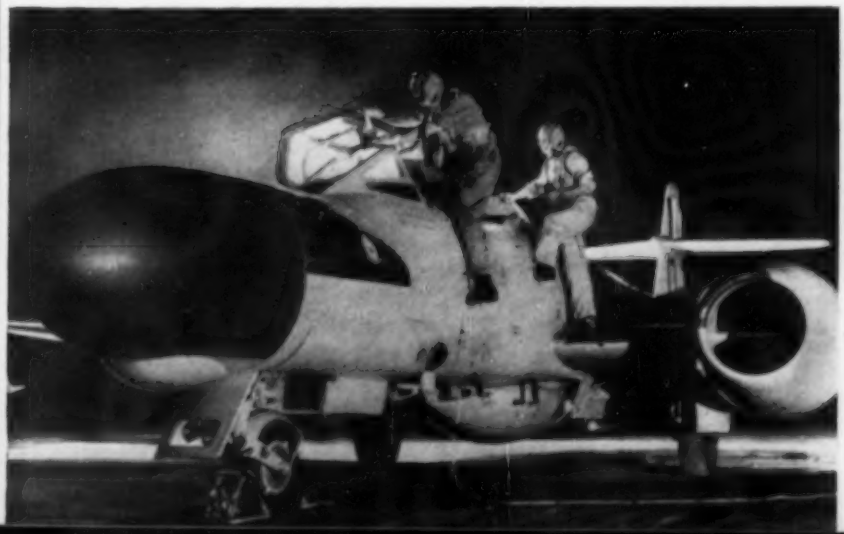
The exercise culminated in an atom-bomb strike on the island, simulated by the dropping of a flare. Civil defence and armed forces dealt with several hundred "casualties" and an army unit cut off from the landward side by bomb damage was redeployed by sea. This operation was watched by the United Kingdom Chief of Civil Defence.

Handling Squadron in Middle East

A TEAM from the R.A.F. Handling Squadron is due to leave Lyneham, Wilts, on August 3rd for a three-week tour of R.A.F. units in the Middle East Air Force and Fleet Air Arm units in Malta. The team of eight, commanded by W/C. J. A. Brignell, O.B.E., D.F.C., will fly in a Varsity.

The Handling Squadron, in collaboration with the Ministry of Supply, is responsible for the preparation of Pilot's Notes, describing the handling characteristics of all types of aircraft as they come into R.A.F. service. It also keeps Pilot's Notes up to date, making changes which may be necessary as more experience is gained with the aircraft in service, and as new factors arise, such as modifications or changes in characteristic for any other reason. Regular visits are made to squadrons at home and overseas to discuss handling questions with the squadron pilots, and any recommendations or suggestions are carefully noted. Each type in current use is reviewed once a year from the handling viewpoint.

R.A.F. units in Cyprus, the Sudan, Kenya, Aden and the Persian Gulf will be visited, and three days will be spent with Fleet Air Arm units in Malta. The Varsity is scheduled to return to its base at Boscombe Down, Wilts, on August 22nd.



F/Os. Jones (pilot) and T. Bate (navigator), of No. 39 Squadron, get aboard their Meteor N.F.11 at Luqa during the recent defence-of-Malta exercise.

Air Chief Marshal Sir John W. Baker presenting the first R.A.F. Technical College Sword of Honour to Sen. U/Off. B. Harris during the passing-out parade held last week.

Joint Indian Ocean Exercise

THE sixth to be held off Ceylon since the war, a Commonwealth Joint Exercise began this week in Trincomalee Harbour, and is to last for four weeks. Forces from the Royal Navy, Indian Navy, Royal Pakistan Navy and Royal Ceylon Navy are taking part, together with aircraft from No. 224 Sqn., Coastal Command, No. 205/209 Sqn, F.E.A.F., and from the Fleet Requirements Unit, Indian Navy.

The forces are under the general direction of the C-in-C. East Indies Station, Vice-Admiral C. F. Norris, C.B., D.S.O., R.N., and the A.O.C. R.A.F., Ceylon, A. Cdre. H. W. Mermagen, C.B., D.F.C.

Operation "New World"

EIGHT Canberras from No. 139 (Jamaica) Squadron, Bomber Command, are to make a training flight to the Caribbean area and Canada, leaving their base at Hemswell, Lincs, on August 9th and returning on September 15th. The flight has been code-named "New World." The aircraft will visit Jamaica during the country's Tercentenary celebrations, and later will take part in the Canadian National Exhibition in Toronto.

In command will be A.V-M. J. R. Whitley, C.B., C.B.E., D.S.O., A.F.C., A.O.C., No. 1 Group, Bomber Command, and his deputy, W/C. B. P. Young, O.B.E., a staff officer of H.Q., No. 1 Group. No. 139 Squadron is commanded

SERVICE AVIATION . . .

by S/L. A. Ashworth, D.S.O., D.F.C., A.F.C.

The Canberras, which will be supported by five Hastings of Transport Command, will fly a total distance of about 21,000 statute miles and altogether 129 officers and airmen will take part in the flight.

In the Caribbean area the Force will visit Jamaica, British Guiana, Trinidad, Grenada, St. Kitts, Barbados, Antigua, the Bahamas and Bermuda. The Canberras will not land at Antigua, Grenada or St. Kitts, but will give flying demonstrations over those islands. During the war the Jamaica bomber fund raised £160,000 to buy bombers for the Royal Air Force.

Two weeks will be spent in Canada, where the Canberras will visit a number of R.C.A.F. stations, giving flying demonstrations and taking part in operational exercises.

Round in 16 Hours

ON July 14th a Canberra of the Royal Australian Air Force circumnavigated Australia (6,000 miles) in 16 hr 40 min. Piloted by F/O. E. G. Camberon, it took off from Amberley, near Brisbane, at 0229 hr and landed at 1909 hr.

Radar-chain Helicopters

HELICOPTERS from 108 Communications Flight, R.C.A.F., at Bagotville, P.Q., have begun operations in connection with construction of the radar chain known as the Mid-Canada Line. Sikorsky S-55 helicopters have already begun flying operations, and the Piasecki H-21As are scheduled to begin their part in the operations during the autumn. The helicopter is assuming a growing importance in R.C.A.F. flying operations. Six Piasecki H-21As and ten Sikorsky S-55s were obtained during the latter part of 1954, for use in search and rescue work and in construction and maintenance of the Mid-Canada Line. In addition, arrangements are being made to obtain as soon as possible a number of Piasecki H-21Cs and Sikorsky S-58s.

The helicopters are operating from advance supply bases set up near the eastern shore of Hudson Bay, and at Knob Lake, in northern Quebec. They are being used to carry engineers and survey parties into the Line area for survey work and selection of suitable locations for helicopter landing "pads" along the system. Responsibility for building the Mid-Canada Line is vested in the R.C.A.F., with a division of Bell Telephone Company to assist in the task.

Fixed-wing operations in connection with the construction of the early-warning system have been going on for some time. No. 408 (P.R.) Squadron from Rockliffe, near Ottawa, completed photographic operations along the entire line during 1954. In addition they photographed rugged sections of the eastern half of the chain, in the area where helicopter work will be extensive. The maps resulting from the aerial survey will aid materially in construction planning and airlift operations during and after the construction phase.

Transport requirements other than the helicopter airlift are being met by commercial air operators but should they be unable to handle this task completely, aircraft of Air Transport Command with headquarters at Lachine, P.Q., will support them. For this purpose, Dakotas of No. 408 Squadron have been equipped with combination ski-wheel landing gear for year-round operation, and have been fitted with JATO units for assisted take off from short strips, which will be located at various lakes along the line.

Materials necessary to build the warning chain will be flown to ice landing strips along the eastern half of the line by fixed-wing aircraft and from these lake-head strips will be carried to their destination by helicopters.

No. 108 Communications Flight, R.C.A.F., is commanded by S/L. R. T. Heaslip, A.F.C., C.D.

"Flight" photograph

Members of Queen's University, Belfast, Air Squadron and their Chipmunks at Odiham, where the unit is in summer camp. S/L. K. A. Perkin, the C.O., is seated third from the left.

R.A.A.F. Units in Malaya

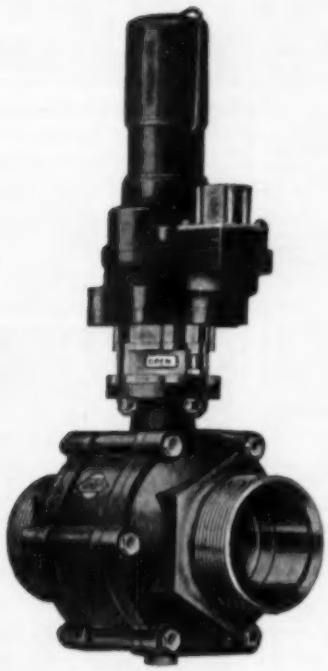
THE first R.A.A.F. unit to go to Malaya under Australia's strategic reserve commitment, No. 2 Airfield Construction Squadron is sending an advance party to Butterworth next month. The remainder of the unit and its heavy equipment will follow by ship early in September.

At a later stage R.A.A.F. operational squadrons will move into Butterworth. They will consist of a fighter wing of two squadrons and a bomber wing of one squadron.

Reunion

THE first post-war reunion of the officers of No. 2 Squadron is due to take place at the R.A.F. Club, 128 Piccadilly, London, W.1, on October 14th. Particulars and tickets (25s) from F/L. R. J. Linford, R.A.F., No. 600 Squadron, R.Aux.A.F., R.A.F. Biggin Hill, Kent.

The Pakistan High Commissioner in London, His Excellency Mohammed Ikramullah, was recently present at the handing-over, at Filton, of the last of a number of Bristol Freighters ordered by the Royal Pakistan Air Force. On the left he is seen with the Begum Ikramullah, G/C. M. Akhtar and Mr. A. J. Pegg after a flight in a Sycamore piloted by Mr. C. T. D. Hosegood; on the right he is inspecting an R.P.A.F. parade in front of the Freighter.



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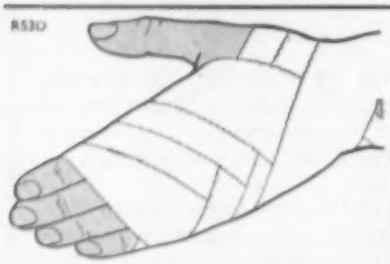

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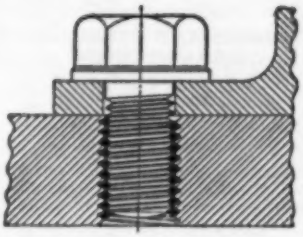

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PUBLIC ANNOUNCEMENTS

AIR TRANSPORT ADVISORY COUNCIL

THE Air Transport Advisory Council give notice that they have received the undermentioned applications to operate scheduled air services:—

APPLICATION No. 546 from East Anglian Flying Services, Ltd., of Southend Airport, Essex, for a Seasonal U.K. Internal Service with DH Dove and DH89a aircraft, for the carriage of passengers, supplementary freight and mail between Portsmouth and Jersey, with an intermediate traffic stop at Guernsey at a frequency of from 12 to 20 services weekly during the season from June to September inclusive each year for a period of ten years, commencing June 1st, 1956.

APPLICATION No. 547 from Eagle Aviation, Ltd., of 29 Clarges Street, London, W.1, for a seasonal Inclusive Tour Service, with Viking and Dakota aircraft, in conjunction with Sir Henry Lunn, Ltd., for the carriage of passengers and supplementary freight between London (Blackbushe) and Ajaccio (Corsica), at a frequency of up to four services weekly, increasing according to traffic demand, during the season from April to October inclusive each year for a period of seven years, commencing April 1st, 1956.

APPLICATION 64/2 from Airwork, Ltd., of 15 Chesterfield Street, London, W.1, for amendments to the terms of approval of the Colonial Coach Service which they are approved to operate between London and Bathurst, Freetown, Takoradi and Accra, the same as those requested by Hunting-Clan Air Transport, Ltd., in Application No. 20/2, which was advertised in "The Times," "The Aeroplane" and "Flight," on July 22nd, 1955.

FROM B.K.S. Air Transport, Ltd., of 1 Marylebone High Street, London, W.1, for the following Seasonal Tour Services to be operated with Dakota and Viking aircraft for the carriage of passengers and supplementary freight, in conjunction with Roberts Tours, Ltd., at a frequency of from one to three services weekly in each case, to be operated on Fridays, Saturdays or Sundays, during the season April to October inclusive, for a period of seven years, commencing May 1st, 1956:—

APPLICATION No. 548 for a service between Newcastle and/or West Hartlepool and/or Leeds and Milan (Malpensa).

APPLICATION No. 549 for a service between Newcastle and/or West Hartlepool and/or Leeds and Nice.

APPLICATION No. 550 for a service between Southend and Milan.

APPLICATION No. 551 for a service between Southend and Nice.

APPLICATION No. 552 from Dragon Airways, Ltd., of Speke Airport, Liverpool, 19, for a Normal Scheduled Service with D.H. Heron aircraft, for the carriage of passengers, supplementary freight and mail between Liverpool (Speke) and Paris

(*Continued in column 2, page 31*)

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PUBLIC ANNOUNCEMENTS

(*Continued from column 2, page 30*)

(Le Bourget), at a frequency of from one to two services weekly, for a period of ten years, commencing October 15th, 1955.

THESE applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on July 30th, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. [4045

MINISTRY OF EDUCATION: Museum Assistants, Science Museum. The Civil Service Commissioners invite applications for five posts in the Science Museum and three posts in the Science Library. Age at least 16 on June 1st, 1955. Candidates should normally have School Certificate or General Certificate of Education or Scottish Leaving Certificate, or equivalent, with qualification in mathematics or a science subject for the Museum posts or a modern foreign language for the Library posts. Appointment may be to the unestablished grade with establishment after not more than two years, or direct to an established post in certain cases.

SALARY:—Unestablished—£227 (age 16) to £502 (men) or £446 (women);
Established—£262 (age 18) to £545 (men) or £469 (women).

STARTING salary according to age, up to £402 (men) or £362 (women) at age 25 or over.

WOMEN'S salaries being improved under equal pay scheme.

APPLICATION Forms from Secretary, Civil Service Commission, Burlington Gardens, London, W.1, quoting No. 143-144/55, to be returned by August 18th, 1955. [4046

PUBLIC APPOINTMENTS

COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF DEFENCE PRODUCTION

Government Aircraft Factories
Fishermen's Bend,
Victoria, Australia

A NUMBER of vacancies exist in the recently reorganised DESIGN and ENGINEERING Sections of the Government Aircraft Factories.

DESIGN SECTION

SENIOR Engineers, £1,688/£1,814 per annum. 4 positions, viz.
- 2543 Chief Stability and Control Engineer.
- 2544 Chief Stressman.
- 2545 Chief Development Engineer.
- 1660 Project Engineer.

ENGINEERS, Grade 3, £1,294/£1,562 per annum. 6 positions, viz.
- 2547 Aerodynamicist.
- 2549 Stability Engineer.
- 2551 Control Systems Engineer.
- 2553 Stress Engineer.
- 2556 Development Engineer (Materials and Methods).
- 2559 Materials Engineer.

ENGINEERS, Grade 1, £890/£1,310 per annum. 4 positions in the following fields, viz.
- 2552 Autopilots and servomechanisms.
- 2550 Stability and Control Calculations.
- 2555 Stress Analysis of Structures (2).

ENGINEERING SECTION

SENIOR Engineers, £1,688/£1,814 per annum. 3 Supervisory positions in the following fields:
- 2565 Design and development of Aircraft and Missile Systems.
- 2566 Design and development of electronic equipment including telemetry and flight simulators.
- 2567 Development of Gyroscopic instruments and mechanisms for radio controlled aircraft and guided weapons.

ENGINEERS, Grade 3, £1,394/£1,562 per annum. 6 positions in the following fields, viz.
- 2568 Electronic and Electrical Control Systems (2).
- 2569 Electronic and Electrical Servo Loop Mechanisms.
- 2570 Radio Control and Telemetry Equipment.
- 2571 Instruments and Instrument Mechanisms.
- 2572 Electronic and Electrical Instruments.

ENGINEERS, Grade 1, £890/£1,310 per annum. 4 positions in the fields stated, viz.
- 2573 Electronic and Electrical Servo Loop Mechanisms.
- 2574 Radio Control Equipment VHF, HF and UHF equipment. Suppressed Aerials.
- 2575 Gyroscopic Instruments and Mechanisms. Defects during manufacture and flight.
- 2576 Telemetry and Radio Control Systems. Defects Investigation.

IN all cases a UNIVERSITY DEGREE or HIGHER NATIONAL CERTIFICATE in the appropriate

(*Continued in column 1, page 33*)

VICKERS-ARMSTRONGS

(AIRCRAFT) LIMITED

WEYBRIDGE, SURREY

REQUIRE

a) **PROGRESS STAFF** (Senior and Junior) with engineering experience.

b) **SUB-CONTRACTS ZONE STAFF** (Senior and Junior). Applicants should have had engineering experience, be capable of handling correspondence and meeting executives of sub-contracting firms.

c) **ELECTRICAL INSPECTORS** for aircraft finals and stage work on electrical installations, testing, etc. Previous aircraft experience not essential —ex-Servicemen with suitable experience are welcomed as applicants. Vacancies at Weybridge and Hurn Depot, Nr. Bournemouth, Hants.

d) **FLIGHT TEST OBSERVERS** — with at least Higher National Certificate in Mechanical Engineering, or equivalent. Must be physically fit for high-altitude flying, and have had aircraft experience.

e) **SENIOR AND JUNIOR DRAUGHTSMEN** for Research and Technical Development.

Applications, quoting date and prefix letter of advertisement, to:

Employment Manager,
Vickers-Armstrongs (Aircraft) Limited,
Weybridge Works, Weybridge, Surrey.

Superannuation Scheme

Canteen facilities

Applicants should be in a position to arrange their own housing accommodation. Assistance can only be given with individual lodgings.

Holidays already arranged by applicants for this year taken into account.

THE

DUNLOP AVIATION DIVISION

COVENTRY

requires

SENIOR DESIGN DRAUGHTSMEN

and

SENIOR & JUNIOR STRESSMEN

for development on aero wheels, brakes, pneumatic and hydraulic controls and various other aircraft accessories.

also

JUNIOR DETAIL DRAUGHTSMEN

The Company's programme offers excellent prospects of permanent, interesting employment under congenial working conditions. Salary will be commensurate with qualifications and experience, full details of which should be sent to:—

The Personnel Manager,
DUNLOP AVIATION DIVISION
FOLESHILL, COVENTRY

VICKERS-ARMSTRONGS (AIRCRAFT) LIMITED

AT HURN
NR. BOURNEMOUTH
HANTS.

HAVE VACANCIES FOR

(g) **DESIGN DRAUGHTSMEN (Senior, Intermediate and Junior)** for an interesting programme of work which includes development, conversion, and new project design.

Applications are invited from **DRAUGHTSMEN** with experience in:

Structure.
Electrical installations and equipment.
Radio.
Fuel systems.
Internal accommodation and/or mechanisms.

Aircraft experience desirable but not essential.

Vacancies for:

SENIOR AND INTERMEDIATE STRESSMEN.

Applications, quoting date and prefix letter of advertisement, to:

Employment Manager, Vickers-Armstrongs (Aircraft) Limited, Hurn Depot, Nr. Bournemouth, Hants.

Additional 'buses operate to and from the Works at starting and finishing times.

Canteen facilities.

Applicants should be in a position to arrange their own housing accommodation. Assistance can only be given with individual lodgings.

Holidays already arranged by applicants for this year taken into account.

INSTRUMENTATION

THE AIRCRAFT DIVISION
OF
THE ENGLISH ELECTRIC COMPANY LIMITED,
WARTON,
near Preston, Lancs.

has vacancies for men with instrument calibrating and testing experience.

Applicants should have O.N.C. or better and preferably have had experience on aircraft instrumentation.

This is an excellent opportunity to work on instrumentation of modern high speed aircraft in a well-equipped laboratory.

DRAUGHTSMEN

with experience of flight test and instrumentation installations are also required in this expanding section of the organisation.

Apply to

DEPT. C.P.S.,
336/7, STRAND, W.C.2,
QUOTING REF. 1014B.

MARSHALL

AIRPORT WORKS
CAMBRIDGE

INSPECTORS (AIRFRAME & ELECTRICAL)

(Housing available to applicants fulfilling specific requirements)

FITTERS (AIRFRAME & ASSEMBLY)

ELECTRICIANS

Some of these vacancies will have special appeal to highly skilled tradesmen interested in Experimental or T.I. Work.

Long-term employment available on modern types of Service and Civilian Aircraft (including Passenger and Transport).

Excellent hostel or lodging accommodation available and in certain circumstances subsistence allowance is paid.

All applications to

EMPLOYMENT OFFICER

SIR W. G.

ARMSTRONG WHITWORTH AIRCRAFT LTD.

have vacancies in their Design Office for

SENIOR DESIGN DRAUGHTSMEN

JUNIOR DESIGN DRAUGHTSMEN

Aircraft design experience is desirable but not essential, and draughtsmen with mechanical or structural engineering background will be given every opportunity to acquire aircraft design experience.

LOFTSMEN

Accurate line and detail full-scale layout desirable but not essential.

Very interesting work with the best possible prospects. Attractive Assurance schemes. Excellent conditions and dining facilities. Generous settling-in allowance during first month, and housing assistance can be afforded to selected applicants. All applications will be treated in strictest confidence.

Apply Personnel Manager,
Sir W. G. Armstrong Whitworth Aircraft, Ltd.,
Baginton, nr. Coventry.

YOUR SKILL CAN BE MATCHED BY OUR SALARY RANGE

TRAINEE DRAUGHTSMEN

Applications invited from suitable men for Training with view to employment as Draughtsmen.

Applicants must—

(a) Be not over 25 years of age.
(b) Have completed National Service.
(c) Hold at least Ordinary National or City and Guilds Certificates, or G.C.E. with 'A' level subjects.
(d) Have a practical background, preferably Apprenticeship.

A reasonable salary will be paid during the training period. Detailed written applications to:

The Personnel Supervisor,

HAWKER AIRCRAFT LTD.

Canbury Park Road,
Kingston-on-Thames,
Surrey.

THE

ENGLISH ELECTRIC Co's

Guided Weapons Division

LUTON & STEVENAGE

invites applications for the following posts:—

CHIEF PROJECT DESIGNER

to head a Project Design Team within the Airframe Department. This team is required to examine proposed new projects up to the stage of engineering feasibility and as such embraces all aspects of missile design, i.e., airframe, control, guidance and propulsion. Thorough experience in all aspects of airframe design is essential; and some knowledge of propulsion, guidance and control work is desirable. Candidates must be of proven technical and administrative ability in this type of work. A suitable degree or equivalent qualification is essential.

SENIOR TECHNICAL AUTHOR (ELECTRONIC)

for preparation of Instruction and Maintenance handbooks. Sound theoretical knowledge of electronics essential, preferably to degree standard, together with the ability to write concise English.

ILLUSTRATORS for ELECTRONIC LAYOUTS

with good radio/radar experience and some drawing office experience, preferably with O.N.C. or equivalent.

These are progressive posts offering attractive salaries to the right men. Housing assistance can be considered, especially for successful applicants from the Greater London Area.

Applications, which will be treated confidentially, to:—

DEPT. C.P.S.,
336/7 STRAND, W.C.2,
quoting Ref. S.A.23G

PUBLIC APPOINTMENTS

(*Continued from column 2, page 30*)

field is the MINIMUM acceptable qualification. For the senior posts, considerable relevant experience is also necessary.

CONDITIONS OF ENGAGEMENT

SUITABLE applicants will be offered permanent appointment to established positions within the Department.

VACANCIES also exist in the temporary establishment, but the tenure of employment is not limited.

FARES

FIRST class boat fares (if first class berths available) of the appointee and dependants will be paid by the Commonwealth, subject to the appointee entering into a bond to remain in the employment of the Commonwealth for a period of not less than three years from date of commencing duty in Australia.

A MORE detailed specification of each vacancy and the qualifications required, may be obtained from the

SENIOR REPRESENTATIVE (AP.32),
DEPARTMENT OF DEFENCE PRODUCTION,
Australia House,
Strand,
London, W.C.2,

together with the relevant application forms.

THE closing date for applications will be Monday, 15th August, 1955, and interviews will be held at an early date. All applications will be acknowledged. [4019

TUITION

CIVIL Pilot/Navigator Licences.

AVIGATION, LTD., provides full-time or intermittent instruction and postal tuition, or a combination of any of these methods to suit individual requirements for the above licences. Instruction can be provided for A.R.B. General, certain specific types, and A.R.B. Performance Schedule examinations. Link-training Dept. (City 1162) situated centrally in London. Full briefing for I/R 25/- hr. Block rate (min. 10 hrs.) 22/6 hr.

For full details apply to: The Principal,
AVIGATION, LIMITED,
30 Central Chambers, Ealing B'way, London, W.5.
Tel.: EALing 8949. [0248

NIGHT Flying, instrument flying, commercial pilot licences. Approved M.T.C.A. private pilot's course. EVERY facility at reasonable rates from

SOUTHEND-ON-SEA MUNICIPAL AIR CENTRE and FLYING SCHOOL, Municipal Airport, Southend-on-Sea, Rochford 56204. [0452

LONDON SCHOOL OF AIR NAVIGATION in conjunction with Airways Aero Associations, Ltd. OFFERS completely co-ordinated and integrated training for professional pilots/navigators.

M.T.C.A. approval for commercial pilots and instrument rating courses, also P.P.L. All ground and air subjects to U.K.'s application ICAO standards. TRAINING focalised London.

FULL-TIME personal coaching Com./IR:Sen./Com:AL:TP:F/Nav. Pungent and effective. HOME study tutorial (correspondence) excellent alternative: full coverage: modern presentation: attractive terms.

LINK, briefing, procedures, airways; R/T. Type rating, general, specific, per. schedules. SUCCESSES highest in country. Rehabilitation from services to civil.

33 OVINGTON Sq., London, S.W.3. KEN. 8221. Flying Base: Croydon Airport. [0277

FREE! Brochure giving details of courses in all branches aero eng. covering A.F.R.Ae.S., M.C.A. exams, etc. Also courses for all other branches of engineering.—Write: E.M.I. Institutes, Dept. F26, London, W.4. (Associated with H.M.V.) [0964

A.F.R.Ae.S., A.R.B.Certs, A.M.I.Mech.E., etc., on "no pass, no fee" terms; over 95 per cent successes. For details of exams and courses in all branches of aeronautical work, navigation, mechanical eng., write for 144-page handbook free.—B.I.E.T. (Dept. 702), 29 Wright's Lane, London, W.8. [0707

LEARN to fly for £26. Instructor's licences and instrument flying for £3/5/- per hour. Night flying £4/5/- per hour. Residence 5 gns weekly. Approved M.C.A. private pilots' licence course. Specialized course for junior commercial pilot's licence. Wiltshire School of Flying, Ltd., Thruxton Aerodrome, nr. Andover, Hants. Tel. Weyhill 352. [0253

BRITAIN'S AIR UNIVERSITY CAN TRAIN YOU for an airline career. Hundreds of today's airline captains and key maintenance personnel are graduates of this famous establishment. Courses are available for Commercial and Airline Transport Pilot's Licences, Instrument Ratings and Maintenance Engineers' Licences.

FOR details of these and other courses apply to:—The Commandant, Air Service Training, Ltd., Hamble, Southampton. [0970

AERONAUTICAL. Comprehensive full-time technical and practical training for careers in all branches of aviation engineering. Diploma course leads to interesting executive appointments in civil aviation design and development, draughtsmanship, maintenance, etc. Extended courses to prepare for A.F.R.Ae.S. and A.M.I.Mech.E. examination. Write for prospectus to Engineer in Charge, College of Aeronautical Engineering, Chelsea, London, S.W.3. Flaxman 0021. [0019

SKYWAYS OF LONDON

have vacancies for the following categories of

AIRCREW

1. CAPTAINS

With ALTP and four-engined experience, preferably on Hermes or Yorks. Salary in range **£1,545** to **£1,745** per annum.

Pension Scheme and Provident Fund facilities.

FIRST OFFICERS

Minimum qualifications: Commercial Licence with Instrument Rating, preferably with four-engined experience. Salary in range **£1,205** to **£1,475** per annum.

Pension Scheme and Provident Fund facilities.

2. ENGINEER OFFICERS

Experience on four-engined aircraft essential and applicants should preferably have Hermes experience and hold "A" and/or "C" licences and basic "O" licence.

Salary during training **£700** per annum rising to £855 on satisfactory completion of training course. Then in-range **£855** to **£1,345**.

3. RADIO OFFICERS

With M.T.C.A. 1st Class Flight Radio Operator's licence (applicants with temporary licences considered)

Salary in range of **£725** to **£1,240** per annum

Excellent allowances and conditions of service for all above grades

Apply with full details of qualifications to:—

PERSONNEL MANAGER,
SKYWAYS, LTD.,
7 BERKELEY STREET,
LONDON, W.1

WORK WANTED

FLUTTER models (low speed) work now undertaken in this field of research. Enquiries to Box 5391. [4050

SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through the local office of the Ministry of Labour and National Service, etc., if the applicant is a man aged 18-64 or a woman aged 18-59 inclusive, unless he or she or the employer is excepted from the provisions of The Notification of Vacancies Order 1952.

A. V. ROE & CO., LTD.,

Aircraft Constructors

MANCHESTER

Require top grade men aged 25-35 in the

ENGINEERING RESEARCH DEPARTMENT

as follows:

TECHNICIANS are required for interesting experimental work on advanced designs of modern aircraft involving a variety of structural tests.

CANDIDATES should possess either an Engineering Degree or the Higher National Certificate.

GOOD SALARIES AND PROSPECTS

PENSIONS AND LIFE ASSURANCE SCHEME

APPLY stating full particulars of age, qualifications, experience and present employment to the:

LABOUR MANAGER

A. V. ROE & CO., LTD.,

GREENGATE, MIDDLETON,

MANCHESTER. [4009

VICKERS-ARMSTRONGS (AIRCRAFT) LIMITED

Supermarine Works

have vacancies for

AERODYNAMICISTS

at various levels for work on stability and control, performance estimation, power plant and ducting systems, and flight test analysis. Applicants should have a degree or a Higher National Certificate in aeronautical engineering and experience in similar work is an advantage. The design offices are situated in a pleasant country setting and transport is arranged from surrounding areas. Assistance given with housing in certain cases. Apply to Personnel Manager, at Hursley Park,

Nr. Winchester, Hants. [3981

CO-ORDINATOR FOR ELECTRICAL INSTALLATION

A POSITION of considerable interest and opportunity is available in our London office, at a salary of £1,300 to £1,500 p.a.

AN engineer is required who has design and practical experience of aircraft electrical installations and wiring.

SOMEONE having experience of working with Government establishments and procedures is preferred.

THE work involves the co-ordination of requirements for power, radar, telemetry and other devices.

APPLY in confidence to Box 5260. [4016

SERVICE ENGINEER

required for electrical systems on the "Beverley" Aircraft.

SOUND practical experience, and theoretical knowledge of modern aircraft A.C. and D.C. circuits essential. Must be prepared to travel.

THIS is a staff appointment, carrying superannuation and free Life Insurance benefits.

APPLICATIONS (in confidence) to the Personnel Manager, Blackburn & General Aircraft, Ltd., Brough, E. Yorks. Mark envelopes "Electrical Service." [3988

E. K. COLE LIMITED (Malmesbury Division).

A VACANCY exists for an Assistant Engineer in the mechanical engineering laboratory dealing with radar scanners and similar mechanisms. Applicants should have had technical training to Higher National Certificate or Degree standard, and knowledge of aircraft stressing methods would be an advantage. [4025

SITUATIONS VACANT

PROPULSION AND FUEL SYSTEM ENGINEER

THERE is a vacancy for this position in the London office of a firm engaged on priority work on a Government contract.

THE position is one of considerable responsibility with opportunities of advancement. It carries with it Senior Staff status with pension.

SALARY £1,300-£1,500 per annum.

APPLICANTS should have practical or design experience of aircraft fuel systems and engine installations. Knowledge of fuel pumps with turbine drives, and liquid rocket motors is desirable though not essential.

WRITE in confidence to Box 5271. [4018

SITUATIONS VACANT

VICKERS-ARMSTRONGS (AIRCRAFT) LIMITED

Supermarine Works

have vacancies for

STRESS ENGINEERS

and

STRUCTURAL TEST ENGINEERS

in their design organisation. Applicants should have a degree or a Higher National Certificate in engineering and experience in similar work is an advantage. The design offices are situated in a pleasant country setting and transport is arranged from surrounding areas. Assistance may be given with housing in certain cases. Apply to Personnel Manager at Hursley Park, nr. Winchester, Hants. [3994

THE GUIDED WEAPONS DEPARTMENT

OF

SHORT BROTHERS & HARLAND, LIMITED

HAS A VACANCY FOR

A CHIEF STRESSMAN

who must be qualified and experienced in Aircraft stressing. Assistance with housing and with removal expenses.

Applications in confidence to:—

STAFF APPOINTMENTS OFFICER

P.O. Box 241, Belfast, quoting S.A. 79

GLOSTER AIRCRAFT CO. LTD.

GLOUCESTER

HAVE VACANCIES ON SUPER-PRIORITY DESIGN AND DEVELOPMENT PROJECTS

FOR

AIRCRAFT DESIGN DRAUGHTSMEN

(SENIOR & JUNIOR)

Consideration will also be given to Draughtsmen with Mechanical, Structural or Electrical experience.

Also

STRESSMEN

(SENIOR & INTERMEDIATE)

for both strength and flutter calculations.

The conditions of employment are good with progressive salary, good sports and welfare facilities, pension scheme, etc.

APPLICATIONS STATING AGE, PREVIOUS EXPERIENCE AND EMPLOYERS SHOULD BE ADDRESSED TO THE

CHIEF DESIGNER

SITUATIONS VACANT

MECHANICAL OR CIVIL ENGINEER

APPLICATIONS are invited for an Engineer to control test equipment and structural installations for priority work on a Government contract. SALARY £1,300-£1,500 per annum.

A GENERAL knowledge of electrical and structural problems relating to new sites would be an advantage, alternatively someone with practical experience of electrical and electronic test equipment, with some mechanical attainments, would be suitable.
WRITE in detail to Box 5270. [4017

DEVELOPMENT ENGINEERS & PHYSICISTS

LOUIS NEWMARK, LTD., have vacancies in their rapidly expanding research and development department for Engineers and Physicists for work on industrial and aircraft instruments. Degree or similar qualifications desirable. Salary according to experience and qualifications. Pension scheme, excellent working conditions, etc. Please apply giving full details of career to: Personnel Officer, Louis Newmark, Ltd., Prefect Works, Purley Way, Croydon, Surrey. [4049

PILOTS required for:

NIGERIA (NORTHERN REGION) GOVERNMENT. Communications flight on contract for 12/24 months in first instance. Salary scale (including expatriation pay) £1469 rising to £1631 a year. Commencing salary according to experience. Gratuity at rate of £150 a year. Outfit allowance £60. Free passages for officer and wife and assistance towards cost of children's passages or grant up to £150 annually for maintenance in U.K. Liberal leave on full salary. Candidates, preferably aged 25-40, must possess Commercial Pilot's licence, Instrument Rating, and Radio Telephony licence, and must have at least 1,000 hours as pilot-in-charge of single- and twin-engined aircraft. Previous flying experience in tropical conditions an advantage. Write to The Crown Agents, 4, Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience and quote M3B/34694/FE [4024

ARMSTRONG SIDDELEY MOTORS LIMITED, invite applications for a senior executive position on gas turbine aero engine Technical Sales. Good knowledge of performance, work and managing ability essential. Please quote reference WTWB, Armstrong Siddeley Motors, Ltd., Coventry. [4033

PERMANENT and progressive posts in the Aircraft division of
LOUIS NEWMARK, LTD.,
at
NEW ADDINGTON.
THE following personnel are required in their Development Drawing Office for work on instrumentation, servo mechanisms and similar equipment.
1. DESIGNER with stress experience;
2. DESIGNERS;
3. DRAUGHTSMEN.
SALARY according to experience and qualifications. Pension scheme, canteen, sports facilities, full welfare amenities, excellent working conditions.
PLEASE apply in writing giving full particulars to Personnel Officer, Louis Newmark, Ltd., Prefect Works, Purley Way, Croydon. [4048
PILOTS required for scheduled and charter flying in East Africa. Caspair, Box 2238, Nairobi, Kenya. [4036
FLYING Instructor required for position in London area. Temporary post, but possibility of permanency. Box 5383. [4031
CLERK/TYPIST required for interesting work connected flying school operating London Area. Box 5384. [4032
SENIOR and junior aircraft draughtsmen required for structural and electrical work in new department of well established firm.
WRITE, stating age, experience and salary required, to Design Office Superintendent, Western Airways, Ltd., Exeter Airport, Exeter, Devon. [4013
AIRCRAFT Engineer req. immed. Minimum A. and C. licences Rapide and Austers. Accom. found if necessary. Apply: Airviews, Limited, Manchester Airport. [4006
VACANCIES exist in Kenya for aircraft engineers experienced in light aircraft and with licences B and/or D. Apply Campling Bros. & Vanderwal, Ltd., Box 1951, Nairobi, Kenya. [3990
TEST and Laboratory Engineers required for gyro and electro mechanical instruments. Apply stating age, experience and salary required to S. G. Brown, Ltd., Shakespeare Street, Watford, Herts. [0147
FLYING boat pilots required immediately for a six months tour abroad. Excellent conditions and allowances. Possibility of permanency. Apply Box 5401. [4037
WOMAN Pilot required preferably with Commercial Licence and some administrative experience for interesting and varied job in U.K. All letters answered. Write Box 5405. [4051
ACCOUNTS Clerk experienced in costing required. Experience in aircraft industry an advantage. Excellent opportunity. Progressive position. Salary according to age and experience. Apply Edgar Percival Aircraft, Ltd., Near Abridge, Essex. [4034
JIG and Tool Draughtsmen required. Interesting projects. Airframe experience desirable. Apply Edgar Percival Aircraft, Ltd., Stapleford Tawney Aerodrome, near Abridge, Essex. Tel. Theydon Bois 2321. [4042
SENIOR Stressmen required. Complete aircraft design, interesting projects. Assistance with housing to approved applicants. Apply Edgar Percival Aircraft, Ltd., Stapleford Tawney Aerodrome, near Abridge, Essex. [4043
FIRST-CLASS Estimator of small machine details required by King Aircraft Corporation, Hillington, Glasgow, S.W.2. Apply in writing to Works Manager stating age, experience and salary required. [4047
REQUIRED immediately, a Licensed Engineer for post of Station Engineer at Fayid, Canal Zone. Applicants must hold current "A/C" Licences preferably endorsed for Hermes/Hercules 773 or similar multi-engined aircraft and capable of obtaining A.R.B. approval on Hermes.
POST will carry temporary Royal Air Force Commissioned Rank. Excellent messing facilities. Good salary and allowances.
APPLICATIONS should be made to Box 5380. [4029
DAN-AIR SERVICES, LIMITED, require Operations/Commercial Assistant at London Office. Age 23-33. Knowledge of traffic handling and air operations essential. Must have good business ability. Apply in writing to General Manager, Dan-Air Services, Ltd., 36-38, New Broad Street, London, E.C.2. [4003
WORKS Manager for new subtantial company in London area manufacturing complete aircraft. Must be top grade man with wide experience and background. Excellent opportunity in progressive organisation. Reply in confidence, full details of experience. Box 5403. [4044
RADIO Inspector required to cover the overhaul and testing of modern Aircraft Radio and Radar Equipment. The post is both permanent and pensionable. Free transport to local towns, canteen facilities. Write fully stating experience and qualifications Airtech Limited, Aylesbury and Thame Airport, Haddenham, Bucks. Phone: Aylesbury 1163. [4030
DEVELOPMENT engineers and technicians required in research department of a well-known firm of precision engineers, particularly for work in connection with servo systems, small precision motors, and gyroscopic instruments. Apply stating age, experience and salary required to S. G. Brown, Ltd., Shakespeare Street, Watford, Herts. [0146
QUALIFIED ENGINEER required to build up and control mechanical test department. Similar experience together with some knowledge of stress analysis required. Good salary for successful applicant, excellent opportunity. Applications, which will be treated in strict confidence, should be sent to Microcell, Ltd., 56, Kingsway, W.C.2. [4027

AERONAUTICAL OPPORTUNITIES
GUIDED WEAPONS

A well known firm in the aircraft industry is starting a new project in a London Office. It is anxious to recruit staff to form an Assessment Group.

Vacancies with unusual opportunities for rapid promotion exist to meet the following approximate requirements:—

ASSESSMENT GROUP.

GROUP LEADER

Age 30/37, Science or Engineering degree standard, experienced in aircraft, or G.W. project or assessment groups, with knowledge of performance and servo-mechanism problems and analysis of flight and laboratory tests. Personality is important.

SECTION LEADERS

Ages 27/35, Science or Engineering degree standard, general experience as for Group Leader but to a lesser extent.

Staff to fill these sections, with various capabilities from Computing to Honours degrees in Science or Engineering.

The age groups specified are given for guidance only and need not deter candidates outside these limits.

Monthly staff appointments carry a compulsory Pension Scheme and Weekly staff a voluntary Superannuation Scheme.

Write in confidence, giving full details of age, previous experience, qualifications held, etc., to:—

BOX A.C. 09766, SAMSON CLARKS, 57-61 MORTIMER STREET, LONDON, W.1.

The following posts are available to designers with a background of aircraft or G.W. experience:

1. ONE SENIOR DESIGNER
2. TWO DESIGNERS
3. JUNIOR DESIGNERS (several posts)

Post 1 is a senior appointment on the monthly staff of the firm and will carry an attractive salary. Applicants are required to have had considerable experience in aircraft or missile design and preferably experience also on project design. The selected applicant will hold a responsible design position and will have considerable scope for originality.

Posts 2 are appointments on the monthly staff of the firm and applicants are required to have had at least 5 years' experience of aircraft or G.W. design work.

Posts 3 are weekly staff appointments and will carry good salaries and excellent prospects.

Assistance can be given to housing selected applicants for posts 1 and 2.

Apply to:

ARMAMENTS DIVISION

SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT LTD.

BAGINTON, NR. COVENTRY

SITUATIONS VACANT

CANADA. Large Montreal Electronics company requires electronics Engineers, electronics Technicians, electronics Draughtsman, Technical Illustrators and Gyroscope Technicians. High rates of pay; passage assistance; pension plan; group insurance. August interviews in United Kingdom. Write, outlining qualifications, to Department "A.C.," Canadian Department of Labour, 61, Green Street, London, W.1. [4020

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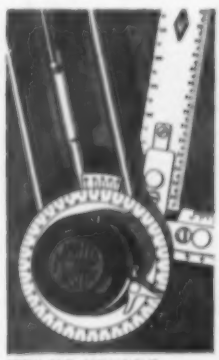

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